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AUSTRALIAN CUMACEA. No. 14[1]

FURTHER NOTES ON THE GENUS *CYCLASPIS*

By HERBERT M. HALE, Director, South Australian Museum.

Fig. 1–21.

Through the kind offices of Dr. A. G. Nicholls, Mr. Keith Sheard, Mr. Gilbert Whitley, and other collectors, there is now available a large number of Cumacea from Western Australian waters, mostly taken with submarine light traps. Notes on the species of *Cyclaspis* represented in this material are included herein.

I am further indebted to Mr. I. S. R. Munro for additional Cumacea from Queensland.

These collections extend considerably the known distribution of some species of *Cyclaspis* and show that the adults from different localities may differ greatly in size (see *C. mollis* and *C. fulgida* herein).

Only three species of the genus were recorded previously from Western Australia, but the following may be listed now as occurring on our Indian Ocean coast:

mjobergi Zimmer
supersculpta Zimmer
candida Zimmer
mollis Hale
fulgida Hale
pura Hale
nitida Hale
cretata Hale
sheardi Hale
spilotes Hale
sublevis sp. nov.
juxta sp. nov.
strumosa sp. nov.
rudis sp. nov.
brevipes sp. nov.

Additional data are given also for *exsculpta* Sars, *cana* Hale, *caprella* Hale, and *globosa* Hale.

One of the new forms—*sublevis*—belongs to the *levis* group and would be placed close to *levis* itself in my key (Hale, 1944, p. 71). Another, *strumosa*, is allied to the New Zealand *coelebs* Calman and is of interest in that the distal setal furniture of the carpus of the posterior peraeopods is unusually feeble and because in the first peraeopod the merus is longer than the carpus.

In the light of further material it is now considered that *mjobergi* Zimmer and *sheardi* Hale, together with *rudis* and *brevipes* spp. nov. would be better

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[1] For No. 13 see *Trans. Roy. Soc., S. Aust.*, lxx, 1946, pp. 178–188, fig. 1–4.

placed alongside *munda* and *pruinosa* in Section 2 of the key, all having the sides of the carapace with at least one tumidity below the pseudorostral suture, no depressed quadrilateral area on the side of carapace in at least the male, and no lateral elevations on the posterior part of carapace. The species concerned are separable thus; it should be noted that the adult female is known only in *sheardi* and (probably) *mjobergi*, and that the key does not necessarily apply to that sex.

1. Ocular lobe not longer than wide 2
   Ocular lobe much longer than wide 5
2. No dorsal pits at rear end of carapace .. .. .. *pruinosa* Hale
   A dorsal pit on each side of midline at rear end of carapace 3
3. Carapace with very feeble horizontal dorso-lateral ridges. Peduncle of uropod longer than rami .. .. *sheardi* Hale
   Carapace with well-developed horizontal dorso-lateral carinae. Peduncle of uropod not longer than rami 4
4. Peduncle of uropod two-thirds as long as rami. Dorsum of carapace corrugated .. .. *rudis* sp. nov.
   Peduncle of uropod equal in length to rami. Dorsum of carapace not corrugated .. .. *brevipes* sp. nov.
5. Carapace with two confluent antero-lateral tumidities below each pseudorostral suture. Three distal carpal setae on third to fifth peraeopods *munda* Hale
   Carapace with one low swelling below each pseudorostral suture. Four distal carpal setae on third to fifth peraeopods .. .. .. *mjobergi* Zimmer

CYCLASPIS CAPRELLA Hale.

Cyclaspis caprella Hale, 1936, p. 395, fig. 1–2, and 1944, p. 74.

The adult female was previously unknown. As with some other Australian representatives of the genus, adult males often occur abundantly in hauls made with submarine light or townet. However, a mass of specimens of the species, taken recently by Mr. W. S. Fairbridge at Kettering, Tasmania, 2–3 fath. with a submarine light, consists largely of adult males and ovigerous females, the latter though outnumbered by the males being quite abundant. The Tasmanian locality extends the known distribution of the species.

Ovigerous female. Integument calcified, but thin and delicate with very fine reticulate patterning.

Carapace less than one-third of total length of animal considerably widened posteriorly, where it is slightly broader than deep and two-thirds as broad as long; the median dorsal carina is sharp on anterior two-thirds, less marked and rugose posteriorly. Anterior horn immediately below the tiny antennal angle on each side as in male and antennal notch shallow, widely open. Ocular lobe narrow (about three times as long as wide) one-seventh of length of carapace and

with the darkly pigmented eye confined to anterior third. Pseudorostral lobes not produced in front of ocular lobe.

Pedigerous somites together little more than half as long as carapace; the first is exposed but dorsally it is very short; second strongly elevated dorsally, its peak rising above level of dorsum of carapace, resulting in a U-shaped or V-shaped space between it and carapace when viewed from side, the dorsum of

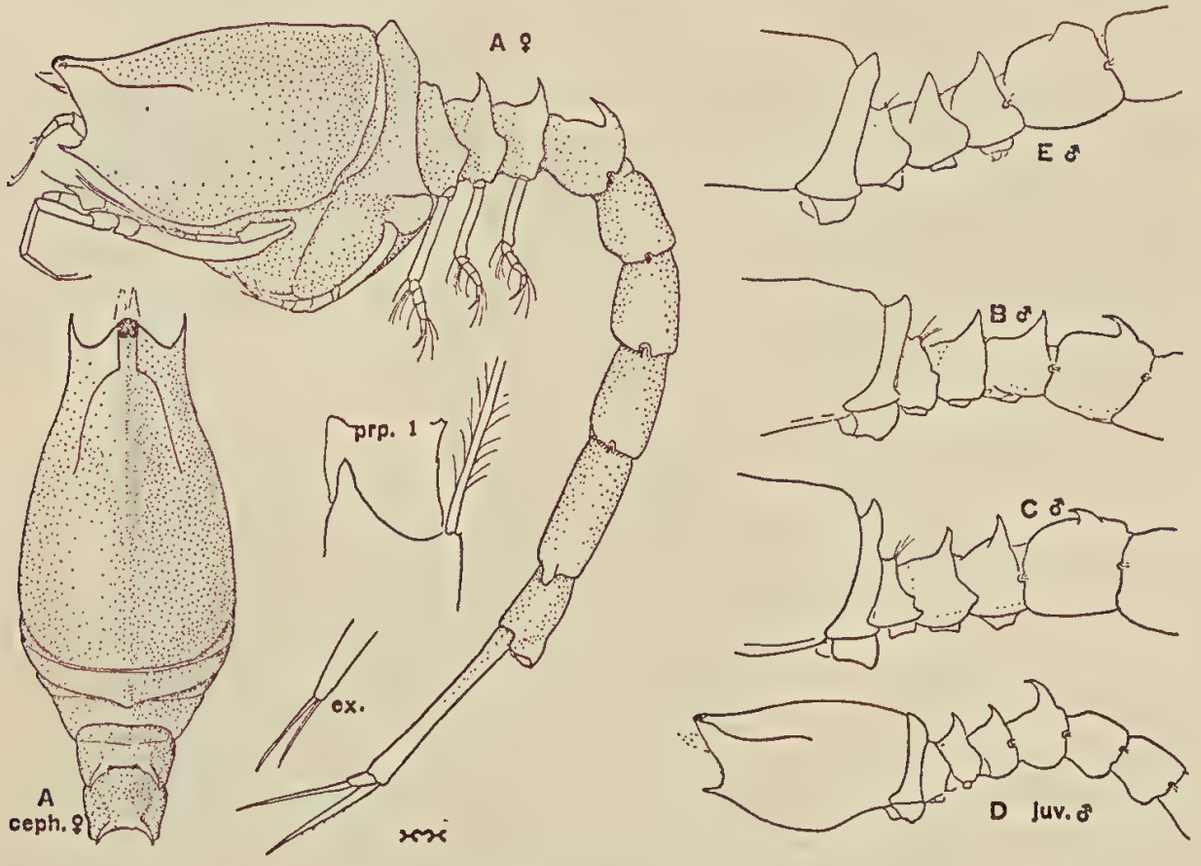

Fig. 1. *Cyclaspis caprella.* Ovigerous female; lateral view and (ceph.) cephalothorax from above (× 23); prp., distal end of basis of first peracopod (× 150); ex., tip of exopod of uropod (× 300). B and C, Pedigerous somites and first pleon somite of adult males, and (D) cephalothorax of young male, from Tasmania (× 23). E, Pedigerous somites and first pleon somite of type male (× 23).

first somite forming the narrow bottom of the gap; third somite not elevated dorsally; fourth and fifth each with a pair of triangular teeth on dorsum.

Pleon longer than cephalothorax; somites, like pedigerous somites, without distinct median dorsal carina except on posterior half of fifth somite where even then it is not at all prominent; first somite with a strong procurved tooth on each side of back, near posterior end.

First joint of peduncle of first antenna as long as combined lengths of second and third segments; second about four-fifths as long as third; flagellum almost as

long as the third peduncular segment and with the first of its two joints fully half as long again as second.

Basis of third maxilliped fully half as long again as remaining joints together.

First peraeopod not very long, the carpus of extended limb reaching barely beyond level of front of carapace; basis shorter than rest of limb, with apex produced on inner (or ventral) side to form a small triangular tooth such as occurs in some other species of the genus (see fig. 1, prp. 1); carpus subequal in length to propodus and nearly half as long again as dactylus.

Second peraeopod with basis a little longer than rest of limb; ischium distinct; dactylus longer than merus, not much shorter than carpus and propodus together, and with longest terminal spine longer than the joint. Posterior legs as in male.

Peduncle of uropod nearly twice as long as telsonic somite, one-fourth as long again as the subequal rami, and without setae, etc., such as are developed in male; exopod with two terminal mucrones (fig. 1, ex.).

Ground colour whitish; carapace and pedigerous somites with stellate dark brown spots; pleon somites also spotted, the chromatophores sometimes arranged to form a band across each.

Length 5 mm.

Males. As in the female the shape of the elevated dorsum of the second pedigerous somite is a little variable in the adult male (cf. fig. 1, A–C). The dorsal elevations of the first pleon somite of mature examples also show differences; in most of the Tasmanian specimens they are developed as a pair of procurved teeth (fig. 1, B), much as in the female, but sometimes they are not nearly so long (fig. 1, C); the extreme in reduction is found in the type, where they are obtuse, triangular, and not at all tooth or hook-like (fig. 1, E). There is also variation in the size of the distal tooth of the basis of the first peracopod.

Young males have the dorsal teeth of the first pleon somite much more pronounced than in the adult; the second pedigerous somite fits intimately against the posterior margin of the carapace, and although dorsally it is raised a very little above the latter, its anterior face does not slope back on the dorsum as in mature examples. The cephalothorax of a juvenile male 3·5 mm. in length, is shown at fig. 1, D.

CYCLASPIS CRETATA Hale.

Cyclaspis cretata Hale, 1944, p. 91, fig. 19–20.

The typical form proves to have a wide distribution in Australia, ranging from lat. 24° to 34° on the eastern coast and between lat. 21° and 33° off Western Australia; a large number of examples, mostly males, are available.

Examples from Queensland and from the western coast of Australia are all a little smaller than the New South Wales type, the adult males being from

4·5 mm. to 5·5 mm. in length, the ovigerous females 4 mm. to 5 mm. The uropods of these smaller males are as in the New South Wales type series, but in the adult females some difference in the armature of these appendages is to be noted. In the type subadult female the uropods are unusual in that the endopod has the spines of the inner margin as in the male. Other New South Wales females have no slender spines near proximal end of this ramus and at most fifteen short spines on the inner margin. The smaller, adult females from Queensland and Western Australia have only from ten to twelve inner spines on the endopod.

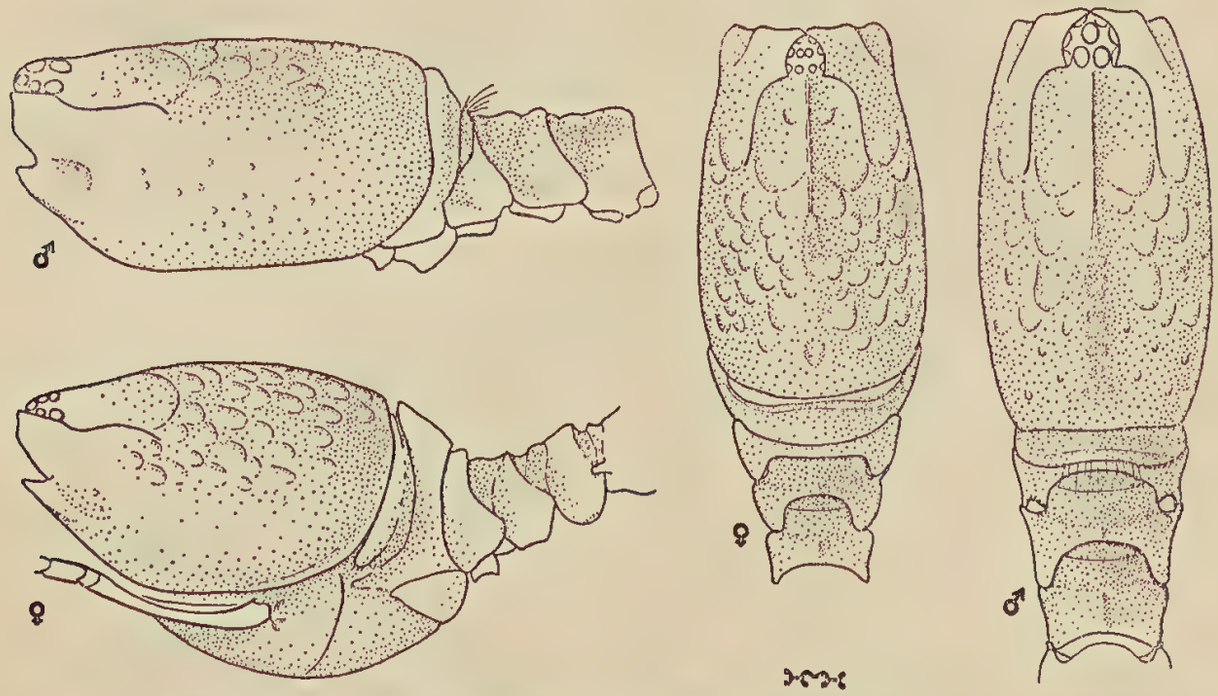

Fig. 2. *Cyclaspis cretata;* cephalothorax of adult male and ovigerous female, from the side and from above (× 30).

In all examples, both male and female, and from all localities, at least the distal third of the endopod of the uropod is unarmed (see fig. 4 A, and Hale, 1944, fig. 20 D).

In the original description of *cretata* some faint indentations posterior to the large anterior dorso-lateral depressions of the carapace were noted. In some examples, particularly amongst Queensland material, these indentations are developed as prominent shallow pits, while in others from the same localities the surface of the carapace is smooth except for the usual minute reticulate patterning. Variation of the superficial patterning is noted elsewhere (see *C. juxta* herein, *Gynodiastylis ornata* Hale, 1946, p. 404, fig. 33–34, etc.) ; it seems also that sculpture of greater significance, in that it is indicative of a group within the genus, may vary in degree of definition in one species, as is noted herein for *C. candida* and *mjobergi.*

C. strigilis Hale (1944, p. 83, fig. 11–14) is very like *cretata*; apart from the minute sculpture of the carapace it differs only in having the rami of the uropod distinctly longer than the peduncle in both sexes. In *cretata* the rami are barely longer than peduncle (adult male) or equal to it in length (ovigerous female).

C. cretata closely resembles *herdmani* Calman also, but the last-named species differs in that the first peraeopods have the propodus, carpus and dactylus equal in length (Calman, 1904, p. 171, and 1907, p. 6).

The first peraeon somite is partly exposed in the ovigerous female of *cretata* (fig. 2) but is wholly concealed in the male and subadult female. The following additional localities may be recorded for the species:

Loc. Queensland: off Moreton Island ("Warreen" Station, submarine light, May, 1936); off Sandy Cape, 25–0 metres ("Warreen" Station, July, 1939); Moreton Bay (I. S. R. Munro, Townet, November, 1940); Noosa River (I.S.R. Munro, March, 1944). Western Australia: Shark Bay, South Passage, 1½ fath., on sand (G. P. Whitley, ex cutter "Isobel," submarine light, November, 1945); Rottnest Island, Thomson Bay (J. Clarke and R. Kenny, submarine light, November, 1945); Abrolhos Islands, Turtle Bay, east Wallabi Island, 2 fath., sandy bottom near coral reefs (G. P. Whitley, ex cutter "Isobel," submarine light, December, 1945).

CYCLASPIS JUXTA sp. nov.

Adult male. Integument calcified thin and brittle; surface of carapace finely reticulate and roughened by a somewhat vermiculate sculpture.

Carapace of same proportions as in *C. cretata* (Hale, 1944, p. 92) but with dorsal outline, as seen from side, slightly irregular because of the minute projections referred to; dorsum medianly carinate and with a shallow dorso-lateral depression on each side in anterior third; antennal notch and tooth, ocular lobe and pseudorostral lobes as in *cretata*.

Second (first free) peraeon somite with dorsal edge, as seen from the side, sloping very obliquely backwards, its anterior margin in the middle a little elevated; each somite with low median carina.

Pleon somites each with a median ridge; telsonic somite with strong dorsal notch.

Antennae and peraeopods very similar to those of *cretata*. The carpus of the first peraeopod reaches a little beyond level of antennal tooth; the basis has, similarly, a distinct inner apical tooth but is longer, being one-third as long again as combined lengths of remaining joints; propodus a little longer than carpus and half as long again as dactylus.

Peduncle of uropod with plumose setae on whole length of inner margin and a second series of slender serrate spines on distal fourth of this margin; it is two-thirds as long again as telsonic somite and is one-fourth as long again as exopod, which is a little longer than endopod and bears about half a dozen plumose setae on proximal half of inner margin; the inner margin of the endopod with nine slender serrate spines in proximal third of length, followed by nine shorter and stouter spines, leaving the distal fourth of the ramus unarmed.

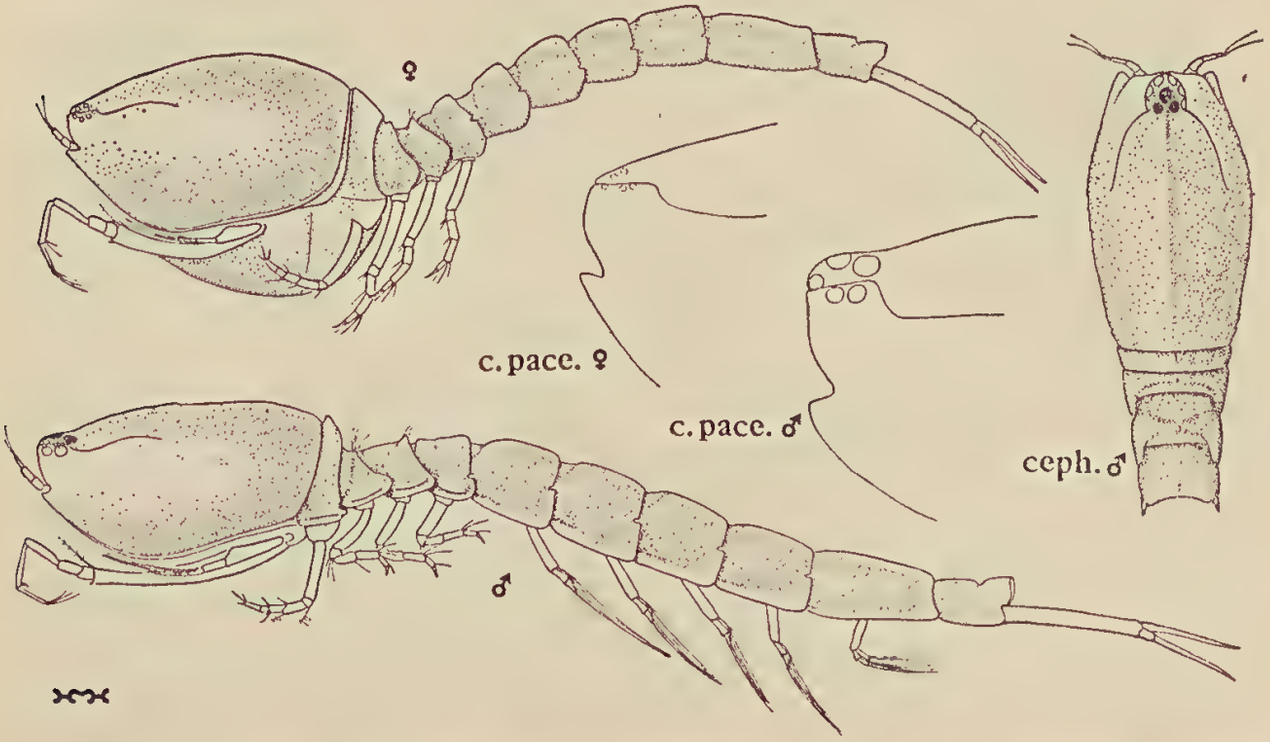

Fig. 3. *Cyclaspis juxta,* types adult female and male; lateral views and (ceph.) cephalothorax from above (× 18; c.pace., frontal portion of carapace from the side, × 42).

Colour semi-transparent, whitish with faint brown mottlings, leaving the inferior portions of last-named pale.

Length 5·2 mm.

Female. Four females are available. These have the integument scarcely at all calcified, evidently as a result of recent ecdysis; the fully developed marsupium is empty but the yellow egg-mass contains large ova (see also Hale, 1944, p. 124, and 1944a, p. 273).

The dorsum of the carapace, as seen from the side, is much more strongly arched than in the male and the ocular lobe is considerably less prominent, with much smaller lenses. The carapace is slightly more than one-third of the total length of the animal and is decidedly more than half as deep as long.

Pedigerous somites together one-half as long as carapace; the first is exposed as a narrow strip; the second slopes back very obliquely on dorsum and is there longer than in male.

Pleon exhibiting the usual sexual differences; it is subequal in length to carapace and pedigerous somites together (one-fourth as long again in male).

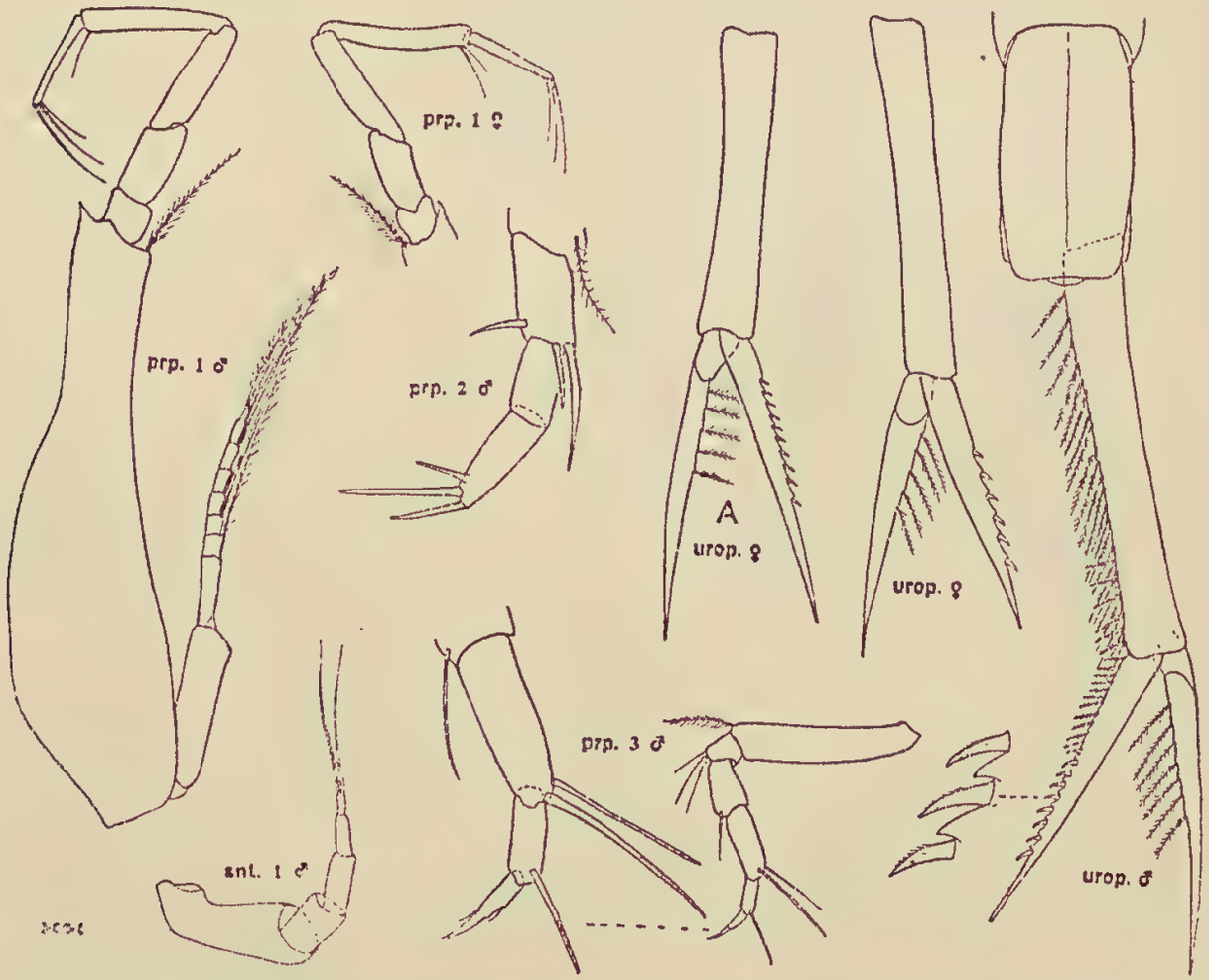

Fig. 4. *Cyclaspis juxta*, paratypes adult male and female; ant. 1, first antenna (× 80); prp. 1, first peracopod of male and (distal joints only) female (× 56); prp. 2, distal joints of second peracopod (× 126); prp. 3, third peraeopod (× 56; distal joints, × 126); urop., uropod, etc. (× 56). A, urop., Uropod of ovigerous female of *C. crctata* for comparison (× 56).

First peraeopod with basis equal in length to rest of limb; propodus three-fourths as long again as dactylus and a little longer than carpus.

Peduncle of uropod nearly half as long again as telsonic somite and one-fourth as long again as exopod; endopod slightly shorter than exopod, its inner margin with six stout spines but no slender spines near proximal end; the distal fourth of the ramus is without spines.

Length 4·4 mm.

Loc. Western Australia: Off Rottnest Island, hauls 22, 24, 26, 27 and 28 (type loc., J. Clarke and R. Kenny, November, 1945); Garden Island (A. G. Nicholls, November, 1946). Types in South Australian Museum, Reg. No. C. 2991–2992.

The carapace exhibits a granulose or vermiculate patterning as a rule, but the sculpture may be evanescent.

Males vary a little in length, the largest attaining to 5·5 mm. The anterior portion of the dorsum of the first free peraeon somite of this sex (as seen from the side) is raised a trifle above the level of the posterior margin of the carapace, so that a minute V, wide or narrow, is left between.

The species is closely allied to *cretata* and might have been regarded as a variant were it not for the fact that three hundred males are readily separated from a large number of examples of the last-named by the character of the uropods. In these appendages the rami are relatively shorter in *juxta*. The peduncle is not or barely longer than the exopod in *cretata*, whereas in the male of *juxta* it is one-fourth or more as long again as this ramus, and in the female it is at least one-fifth as long again. The endopod is furnished with fewer inner spines, which in the female, and on the distal half of the ramus in the male, are larger, while much less than the distal third of the endopod is unarmed (see fig. 4, urop. ♀ and cf. fig. 4, urop. ♂ with Hale, 1944, fig. 20 D). Further, in the male of *juxta* the slender spines on proximal part of inner edge of the endopod are more numerous; there are here nine or ten serrate spines followed by seven to eleven shorter and stouter spines. In the ovigerous female of *juxta* the endopod, as noted above, has half a dozen inner spines instead of at least ten as in *cretata*.

CYCLASPIS PURA Hale.

Cyclaspis pura Hale, 1936a, p. 405, fig. 1–2; 1937, p. 61; 1944, p. 106, fig. 31–32.

Nearly three thousand examples of this species were taken by Dr. A. G. Nicholls and students from Careening Bay, Garden Island, Western Australia, during the night of November 26–27, 1946, with submarine light trap. Approximately 90 p.c. are adult males between 4 mm. and 4·5 mm. in length; these have the peduncle of the uropod approximately half as long again as the rami, a feature obtaining in larger examples previously described from South Australia (Hale, 1944, p. 109); only six ovigerous females are present in the catches from Garden Island.

C. pura was known previously only from South Australia.

Mr. Keith Sheard recently sent for examination a specimen collected by him during the 1939 "Warreen" investigations. This was secured by townet at the surface, March, 1939, at 4 a.m., 40 to 50 miles offshore in Lacepede Bay, South

Australia (lat. 36° 35′ S.; long. 138° 50′ E.); the depth of water at this spot was 40 fathoms. This example is considerably larger (7·8 mm. in length) than any of the inshore material which has been described; the peraeopods are as in the larger littoral males (Hale, 1944, p. 109), but the carpal and propodal setae of the fossorial legs are longer, while the uropod has the peduncle relatively a little more elongate, it being more than half as long again as the rami.

CYCLASPIS NITIDA Hale.

Cyclaspis nitida Hale, 1944, p. 109, fig. 33–34.

A large number of males taken in November, 1945, by J. Clarke and R. Kenny off Rottnest Island, Western Australia (lat. 32° S.), are 4 mm. in length and in other respects agree closely with the type material from the east coast of Australia in lat. 34° S. Other males were captured at Esperance Bay (January, 1945) and also at Garden Island (November, 1946), Western Australia, by Dr. A. G. Nicholls, both localities lying between the latitudes mentioned.

This species has not been taken off southern Australia.

CYCLASPIS SUBLEVIS sp. nov.

Adult male. Integument not calcified, thin and almost membranous.

Carapace with dorsal margin slightly and evenly curved except for the tumid eye-lobe; it is not much more than one-fourth of total length of animal, is as wide as deep and is nearly twice as long as deep; seen from above the sides are evenly curved and the carapace is not noticeably narrowed towards the front; the dorsum is rounded from side to side and has only very feeble indication of a median longitudinal carina; antennal notch very widely open and antennal tooth subacute; pseudorostral lobes with anterior margin somewhat obliquely truncate, both as seen from above and from the side, just meeting in front of ocular lobe, which is as wide as long and has distinct corneal lenses.

The four exposed pedigerous somites together are more than half as long as carapace; all are smooth or almost so.

Pleon robust and very long, fully one-third as long again as cephalothorax; it has an indistinct median longitudinal carina on dorsum and the usual articular pegs are present, but are very small; first to fourth and telsonic somites subequal in length, fifth nearly one-third as long again; telsonic somite narrow, twice as long as wide, only slightly dilated towards distal end, which is produced over bases of uropods.

First antenna with basal joint of peduncle almost as long as combined lengths of second and third joints; third barely shorter than second and longer than the

two-jointed flagellum. Second antenna with flagellum reaching to middle of length of peduncle of uropod.

First peraeopod with carpus reaching to level of antennal tooth; basis more than one-third as long again as rest of limb and with a strong inner tooth at distal end as well as the usual plumose seta at external distal angle; carpus shorter than propodus and one-third as long again as dactylus.

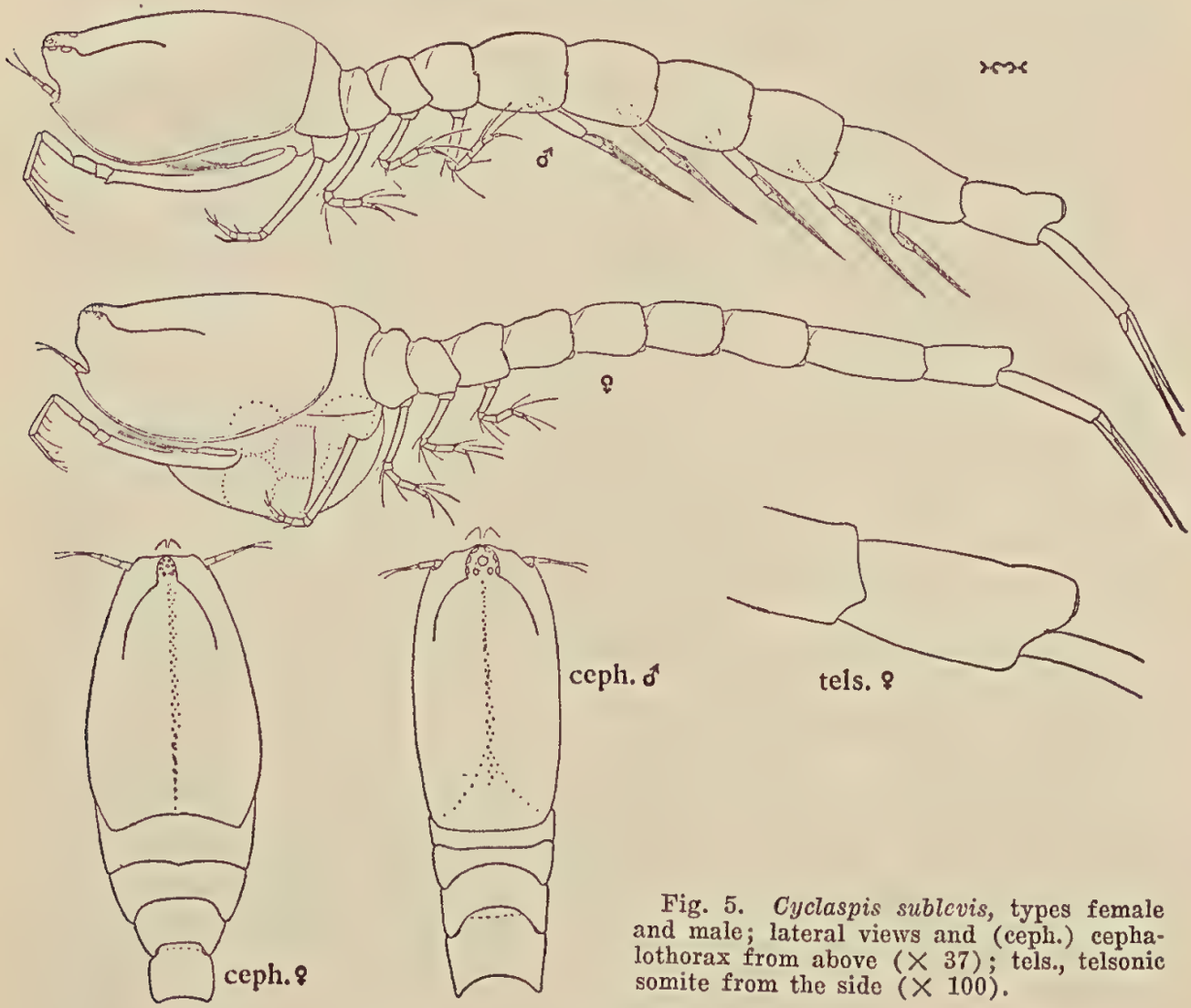

Fig. 5. *Cyclaspis sublevis*, types female and male; lateral views and (ceph.) cephalothorax from above (× 37); tels., telsonic somite from the side (× 100).

Basis of second peraeopod elongate, two-thirds as long again as combined lengths of remaining joints; ischium distinct; merus more than half as long again as carpus, which is armed with a long, outer distal spine, reaching beyond middle of length of dactylus, and a shorter spine on inner margin; dactylus three-fourths as long again as propodus, with the longest of its three distal spines fully as long as the joint; the two others are subequal in length and are two-thirds as long as the longest spine.

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Third to fifth peraeopods slender, with the basis not quite as long as rest of limb; carpus half as long again as propodus and with two distal setae, the longer, like that of propodus reaching well beyond tip of dactylus; the latter is unusual in that its distal portion, for fully two-thirds of its length, is bristle-like (see fig. 6, prp. 3, dactylus).

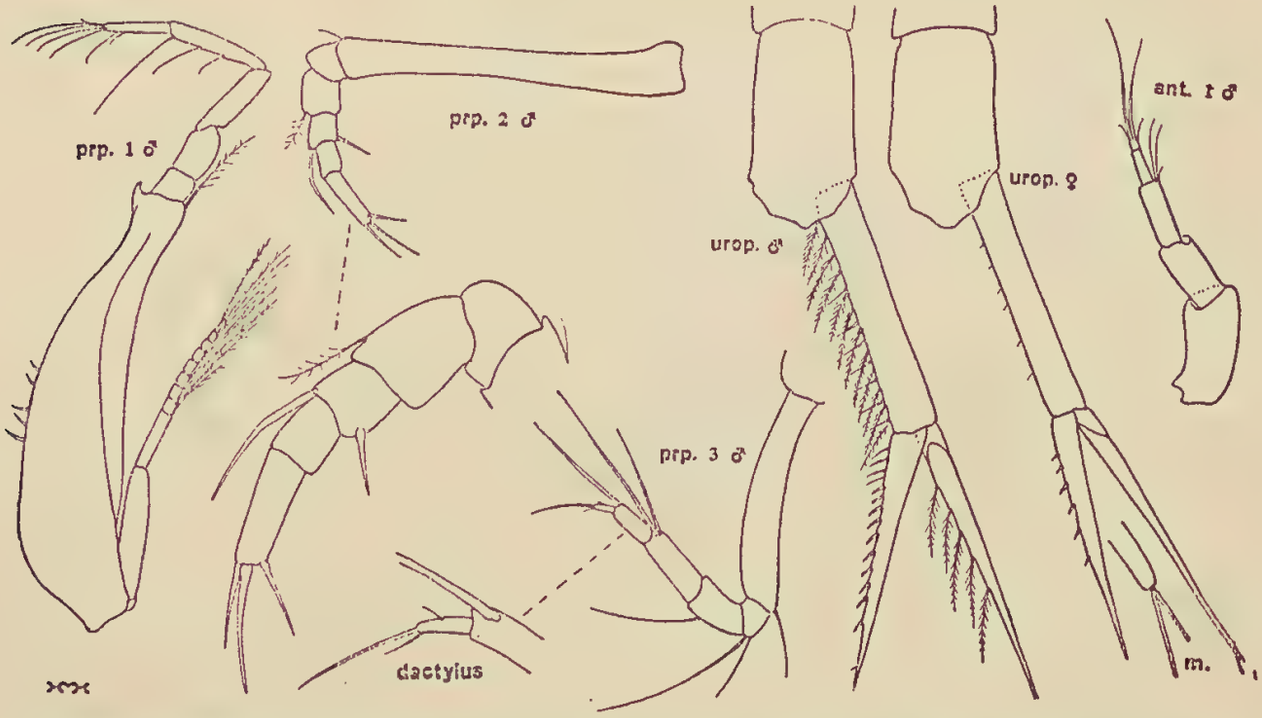

Fig. 6. *Cyclaspis sublevis*, types female and male; ant. 1, first antenna (× 126); prp. 1, first peraeopod (× 74); prp. 2–3, second and third peraeopods (× 116; dactylus, × 250); urop., uropod and telsonic somite (× 74; m, mucrones of exopod, × 250).

Peduncle of uropod one-fourth as long again as telsonic somite and equal in length to the endopod, its inner margin for the whole length furnished with plumose setae, below which, in posterior two-thirds, is a second series of shorter setae; exopod slender, about one-tenth as long again as endopod, with five plumose setae on inner margin and with a pair of mucrones at apex; inner margin of endopod with four slender spines near proximal end, followed by a series of ten shorter and stouter spines, and with a tiny spine not far from the simple and acute distal end.

Colour: transparent, except for a few scattered chromatophores.

Length 3 mm.

Ovigerous female. Carapace dilated in posterior half, where it is distinctly wider than greatest depth; it is two-sevenths of total length of animal. Ocular lobe smaller and relatively narrower than in male, and antennal notch less widely open.

Only four pedigerous somites exposed; together they are almost two-thirds as long as carapace.

Pleon slender but only one-fifth as long again as cephalothorax; the articular pegs are so minute that they are difficult to detect; telsonic somite much as in male.

Peraeopods much as in male but basis in first pair relatively shorter, being equal in length to rest of limb.

Peduncle of uropod one-fourth as long again as telsonic somite and equal in length to endopod; exopod a little longer than endopod, and with two elongate unequal mucrones at distal end (fig. 6, urop., m.); endopod with only half a dozen small spines on inner margin, the distal third unarmed and tapering to an acute apex.

Colour as in male.

Length 2·8 mm.

Loc. Western Australia: Broome, 3½ fath., on sandy mud (type loc.) and Vlaming Head, North-West Cape, 2 fath., sandy bottom (G. P. Whitley, ex cutter "Isobel," submarine light, September and November, 1945, surface temperatures 24·10° and 24·93° C.). Types in South Australian Museum, Reg. No. C. 2997–2998.

This species belongs to the *levis* group and in the writer's key (Hale, 1944, p. 71) would fall in Section 1, between 27 and 29. Of the species there included, it apparently most resembles the much larger New Zealand *calmani* Hale (=*levis* Calman *nec* Thomson), but in the last-named the basis of the first peraeopod has no distal tooth and the rami of the uropod are relatively not as long, the exopod being considerably shorter than the peduncle; Calman (1907, p. 8, pl. v, fig. 6–8) does not describe the posterior peraeopods and doubtless these also will exhibit differences.

The long and slender dactylus of the third to fifth peraeopods serves to at once separate *sublevis* from the other four species of the abovementioned group. Of these, only *cottoni* Hale has similar setal armature on the posterior peraeopods, but the uropods are distinctive.

CYCLASPIS STRUMOSA sp. nov.

Adult male. Integument calcified and brittle. Carapace with the surface reticulate patterning relatively coarse.

Carapace less than one-third of total length of animal, as wide as long and three-fourths as long again as deep; about midway along the length of each side the carapace is slightly swollen and there is a low tumidity below the posterior half of each pseudorostral suture; viewed from above the sides are sinuate, partly because of the large lateral swellings and partly owing to the fact that the area below the antennal notch flares outwards, the outer limit of the expanded portion

defined by a carina running back from the antennal tooth; there is no distinct longitudinal carina on the back of the carapace; the mid-line is angularly rounded and in anterior half of carapace is elevated to form a series of low tubercles, so that seen from the side the front portion of the dorsum presents a slightly corrugated appearance. Pseudorostrum widely truncate, the lobes barely meeting in front of ocular lobe. Antennal notch moderately open and antennal tooth subacutely rounded. Ocular lobe broad, as wide as long, with large and prominent corneal lenses; frontal lobe with the pair of pits so often present.

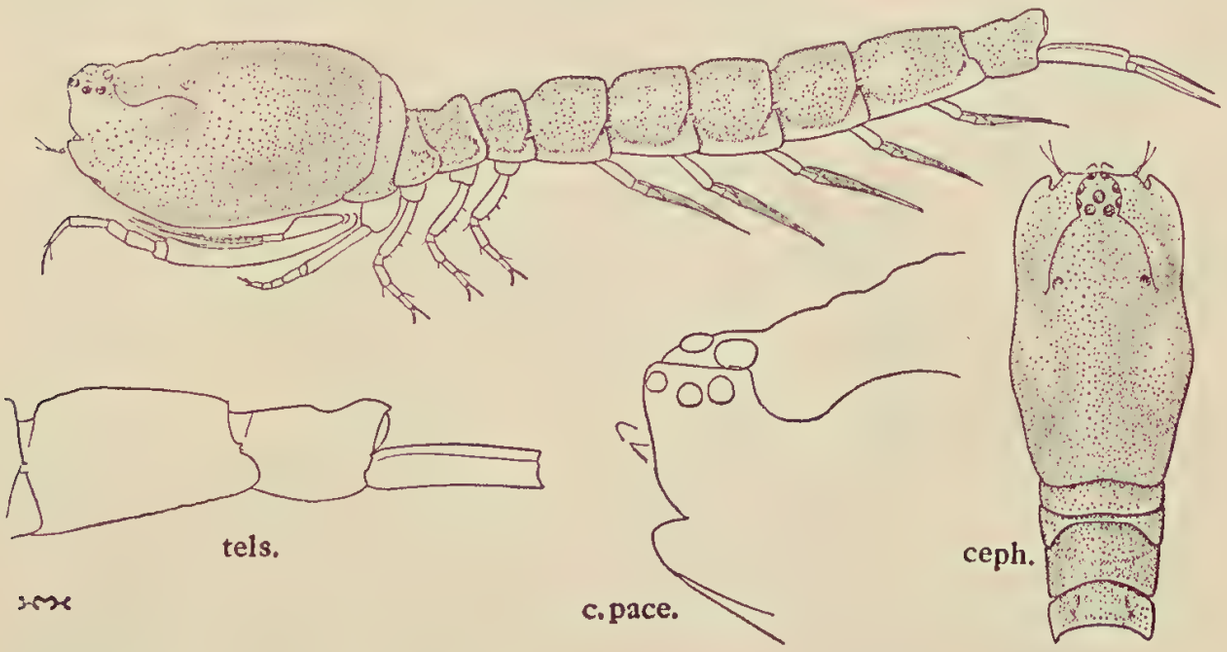

Fig. 7. *Cyclaspis strumosa*, type male; lateral view and (ceph.) cephalothorax from above (× 21); c.pace., anterior portion of carapace (× 40); tels., peduncle of uropod with fifth pleon and telsonic somites, from the side (× 40).

Four pedigerous somites exposed; together they are half as long as carapace; the dorsum of the second slopes backwards very obliquely and the lateral areas of the third to fifth are moderately prominent; the back is smooth except for a feeble dorso-lateral carina on each side of fifth, all somites lacking a median longitudinal carina.

Pleon only one-seventh longer than cephalothorax; first to fourth somites swollen on sides, rounded on back but without ridge on mid-line; fifth somite tapering to rear with sides sinuate; it is widest near the base and has a distinct median longitudinal dorsal carina in posterior half; telsonic somite about three-fourths as long as fifth pleon somite; it is narrow, being nearly twice as long as greatest width, which occurs near distal end, and has a dorsal carina on mid-line of proximal half; the dorsal notch is shallow.

Second antenna with flagellum reaching beyond end of pleon.

First peraeopod with distal portion short, the propodus of the extended limb not quite reaching level of antennal tooth; basis two-thirds as long again as combined lengths of remaining joints, without distal tooth but with the usual external apical seta; carpus a little shorter than merus, five-sixths as long as propodus and barely shorter than dactylus, which has one of the setae of distal end long and stout.

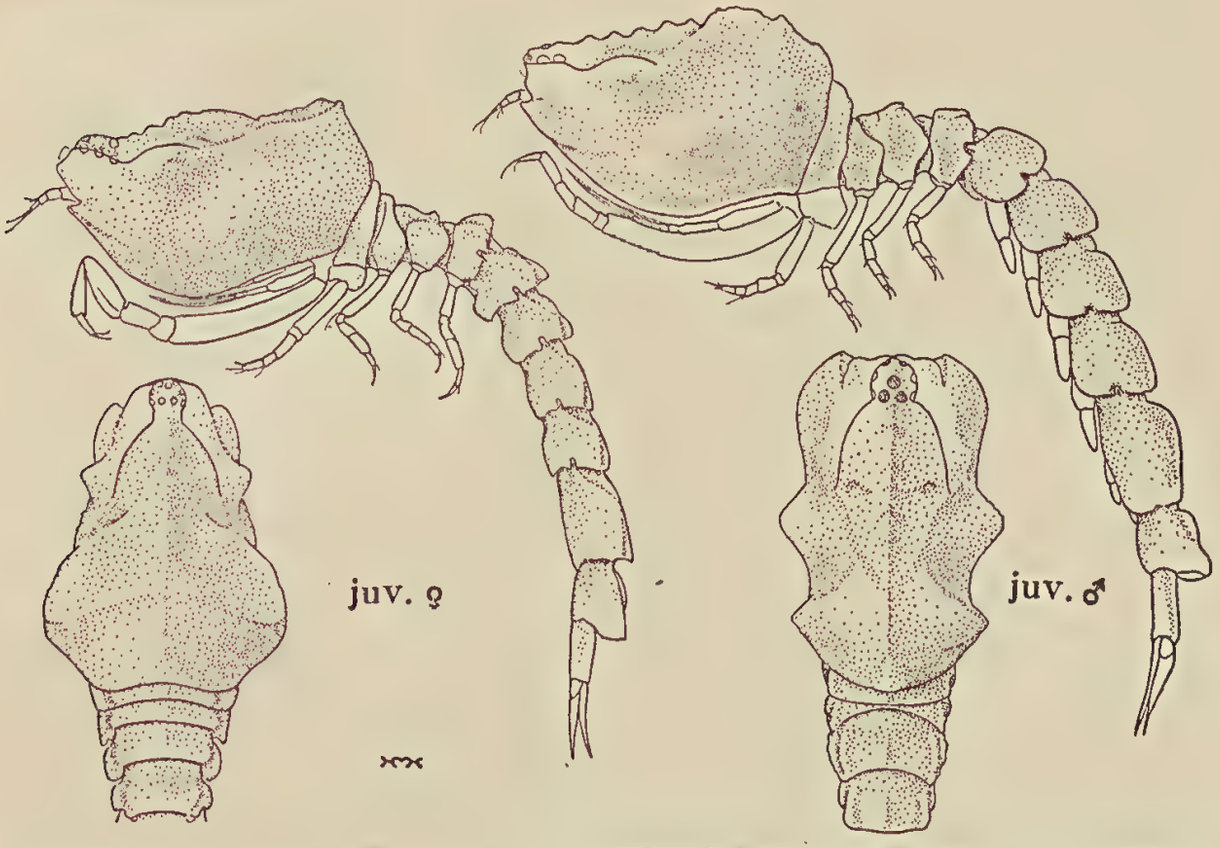

Fig. 8. *Cyclaspis strumosa,* lateral views and cephalothorax from above of subadult male (× 15) and young female (× 19).

Basis of second peraeopod fully as long as rest of limb; dactylus nearly half as long again as propodus and distinctly shorter than either merus or carpus, which are subequal in length; the longest distal dactylar spine is almost as long as combined lengths of dactylus and propodus, while the other two are short and subequal.

Basis of third peraeopod longer than rest of limb; that of fourth and fifth about equal in length to remaining joints together; carpus of posterior legs barely longer than propodus; setal armature very unusual in that the carpus bears only a single distal outer seta, which is very short (not reaching beyond the distal end of propodus) and is much more slender than the propodal seta; the last-named is stout and reaches almost to tip of dactylus, which is slender and is equal in length to propodus.

Uropod with peduncle barely longer than telsonic somite, equal in length to exopod and with two series of setae on the distal half of the serrate inner margin; exopod subequal in length to endopod and with eight plumose setae on inner margin; endopod with both margins serrate, its inner edge with ten slender spines in proximal half, followed by two stouter and shorter spines.

Colour yellow, closely spotted all over with minute, brown chromaophores. Length 5 mm.

Loc. Western Australia: Off Onslow, Airlie Island, 3 fath., on rock, coral and sand (G. P. Whitley, submarine light, ex cutter "Isobel," 7·40 p.m. to 8 p.m., September, 1945, surface temperature 21·6° C.). Type in South Australian Museum, Reg. No. C. 3012.

The salient features of the adult are found in the proportions of the joints of the first peraeopod, where the merus is *longer* than the carpus, in the setal furniture of the third to fifth peraeopods and the tumidities of the carapace. In the key to the species (Hale, 1944, p. 71) *strumosa* would fall near the New Zealand *coelebs* (described from the adult male only, see Calman, 1917, p. 150, fig. 5). Calman's figure shows a single short carpal seta on the posterior peraeopods and his species in some other respects shows affinities but is at once separated by the very different proportions of the limb joints, while the exopod of the uropod has an apical spine. In *coelebs* the sides of the carapace have in the posterior half a faint curved carina, approximating to the hinder limits of the lateral tumidities of *strumosa*.

Two immature examples, a subadult male and a juvenile female, are described below as possibly co-specific with *strumosa*.

Subadult male. Seen from the side the dorsum of the carapace exhibits a corrugated outline, but posteriorly over the branchial regions it is much more elevated, there being a conical prominence on each side; below this tumidity and approximating to the postero-lateral tubercle on the second transverse ridge of the *exsculpta* group (Hale, 1944, fig. 2) there is another conical elevation, most evident in dorsal view. There is a deep hollow on each side—the quadrilateral area of the *exsculpta* group—emphasized above by a subconical elongate elevation below the frontal lobe and continued back as an ill-defined dorso-lateral fold, and below by a similar prominent protuberance, which, like the postero-lateral hump, materially affects the lateral contour when the animal is viewed from above (fig. 8). The antennal ridge is well defined, just as in the adult.

Carinae of pedigerous and pleon somites as in adult, but less conspicuous. Pleon only about one-tenth as long again as cephalothorax and exhibiting the differences usual in subadults of members of this sex in the genus.

Basis of third maxilliped not much more than half as long again as remaining joints together.

First peraeopod relatively shorter than in adult; basis fully half as long again as rest of limb; carpus a little shorter than merus, a little shorter than propodus and subequal in length to dactylus.

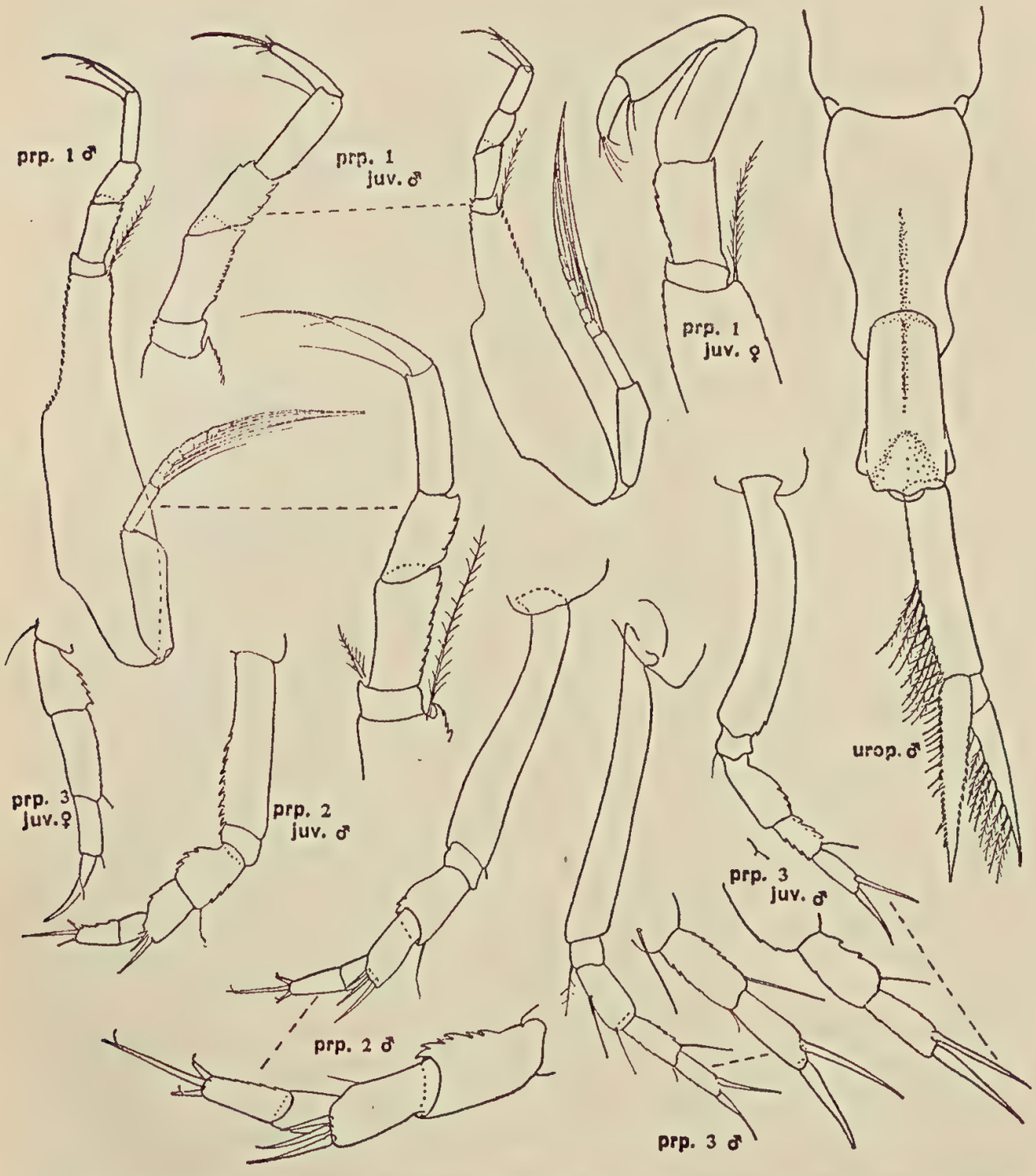

Fig. 9. *Cyclaspis strumosa*, paratype adult male, and young male and female; prp. 1, first peraeopod (× 50; distal joints only, × 62); prp. 2–4, second to fourth peraeopods (× 62; distal joints only, × 160); urop., uropod with fifth pleon and telsonic somites (× 50).

Second peraeopod relatively shorter than in adult.

Third to fifth peraeopods with one short distal carpal seta and with propodal seta stout and reaching almost to level of tip of dactylus.

Peduncle of uropod little more than two-thirds as long as subequal rami.

Colour white, with faint brown spots on carapace.

Length 3·7 mm.

Loc. Western Australia: Off Garden Island (G. P. Whitley, submarine light, 6.50 p.m.–7.10 p.m., July, 1945). Reg. No. C. 2843.

Although it was taken far to the south of the type locality (lat. 21·5° S. and 17° S.), it is highly probable that this is a young male of *strumosa*. We find as important connecting characters the unusual proportions of the distal joints of the first peraeopod and the unusual setal armature of the third to fifth peraeopods. The elongation of the carapace of the adult male and the "smoothing out" of the sculpture is no more marked than in, for instance, *tribulis* (see Hale, 1944, p. 114).

It may be postulated that, as in some other members of the genus, the sculptured forms in particular, the young male resembles the female more closely than does the adult male. Acceptance of the subadult male described above as belonging to *strumosa* leads one also to place here, with far more hesitation, a juvenile female from Queensland (lat. 27·2° S.) which has somewhat similar sculpture.

Immature female. As in the young male described above the integument is well calcified, with fine reticulate patterning; parts of the carapace are faintly granulate.

Seen from above the conical tumidities below posterior part of frontal lobe (antero-lateral tubercles) project conspicuously, but the greatest width of the carapace occurs across the branchial regions, which flare upwards and outwards on each side and are crossed by a transverse carina which continues completely across the back, meeting, at widest point of latter, a ridge running forward to end of suture of frontal lobe, where there is a small tumidity; seen from the side the carapace is elevated dorsally at about middle of length, and both anterior and posterior to this are smaller tumidities, resulting in a very irregular dorsal outline; a well-defined ridge extends back from antennal angle for about one-fourth of length of carapace; the mid-line is roof-shaped in anterior two-thirds, is slightly depressed between the branchial regions (where to the rear it is marked by a fine impressed line) and is slightly elevated at the rear end. Ocular lobe wide; antennal notch and angle as in males described above.

Dorsal lengths of second (first exposed) and third pedigerous somites together equal to fourth; second to fifth each with a dorso-lateral swelling on each side, most apparent on last two somites.

Pleon about equal in length to cephalothorax; somites one to five, and anterior

part of telsonic somite, with median carina and with a dorso-lateral ridge on each side, the latter becoming less distinct on posterior somites.

First peraeopod with basis not longer than rest of limb; carpus and propodus subequal in length, each longer than ischium and merus together.

Dactylus of second peraeopod not much longer than propodus, but with shorter terminal spines more unequal than in adult male described above.

Carpus of posterior legs much shorter than propodus and dactylus together, and with one very short distal seta; propodal seta also not nearly reaching level of apex of dactylus (fig. 9, prp. 3, juv. ♀).

Peduncle of uropod about two-thirds as long as the subequal rami.

Colour white.

Length 2·7 mm.

Loc. Queensland: Off Moreton Island ("Warreen" Station, 6.30 p.m.–7.30 p.m., May, 1939). Reg. No. C. 2842.

Remarks. This young female is linked to the subadult male from Western Australia by the row of median dorsal tumidities behind the ocular lobe, the strong antennal ridge, wide eye-lobe, the character of the third maxilliped, etc. In general the sculpture is much as in the aforementioned male, but the appearance of the carapace as viewed from above is very different because (1) the lateral tumidity behind and below the antero-lateral tubercle is less elevated; (2) the prominences over the branchial regions are much more pronounced.

As mentioned already, the identification of the small female is open to doubt. The first peraeopod (fig. 9, prp. 1, juv. ♀) exhibits considerable differences and resembles far more closely that of *brevipes* sp. nov., while the pleon differs from the adult in the dorsal carination.

CYCLASPIS SPILOTES Hale.

Cyclaspis spilotes Hale, 1928, p. 36, fig. 5–6.

This species was known previously from a single male, 11 mm. in length and taken in South Australia. It proves, however, to be not uncommon near Rottnest Island, Western Australia, where a large series was secured at five localities by J. Clarke and R. Kenny in November, 1945.

Most of the Western Australian specimens are males, which differ from the type in being of smaller size (7 mm. to 8 mm. in length), and in the absence of defined dorso-lateral carinae on the pleon; in the type these ridges represent the upper edges of lateral tumidities of the first six abdominal somites, swellings which are rounded above in the Western Australian material. The pitting of the carapace is variable and in some examples the pits are larger than in others; the distinctive oblique lateral carina of the carapace is easily discernible. As in the

South Australian example the peduncle of the uropod is about one-fifth as long again as the exopod and bears an inner fringe of long setae with short plumes and a second series, in posterior half, of shorter, slender serrate spines; the exopod is a trifle longer than the endopod and is furnished with a row of six to ten stout spines on inner margin (usually tending towards the higher number) and two or three terminal "spines," one of which is long and conspicuous (fig. 10, sp.); the endopod has the distal end acute but unarmed and bears on the inner margin about half a dozen slender serrate spines, followed by a row of eleven, or thereabouts, of stouter and shorter spines; the distal fifth of length is unarmed.

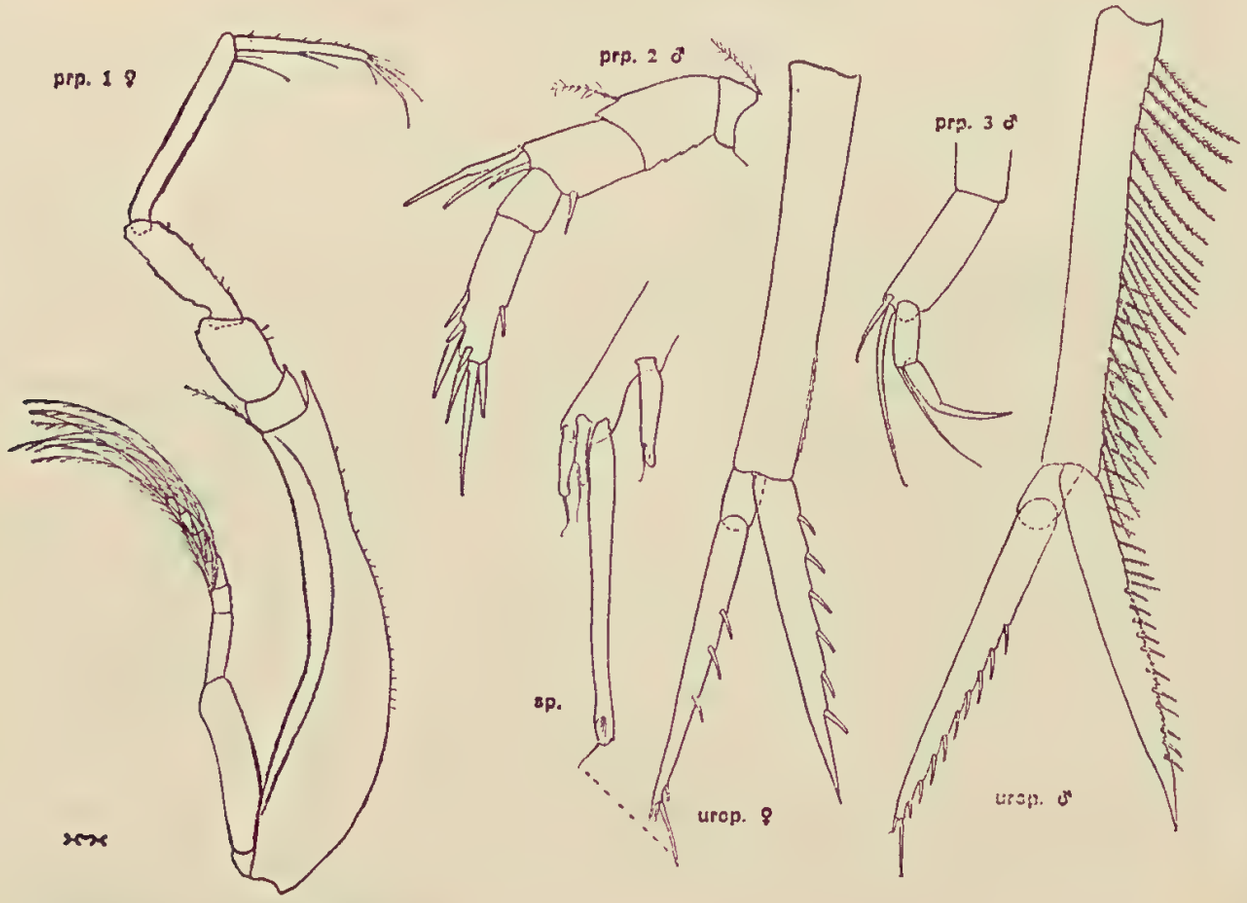

Fig. 10. *Cyclaspis spilotes*, ovigerous female and adult male; prp. 1, first peraeopod (× 47); prp. 2 and 3, distal joints of second and third peraeopods (× 80); urop., uropod (× 47; sp., distal spines of exopod, × 252).

Adult female. Amongst the Western material are several females, 6 mm. to 7 mm. in length, all of which have the integument soft and scarcely or not calcified. These have the marsupium fully developed; in some cases the brood-pouch is empty and the yellow ovaries contain large eggs, in others there are ova in the marsupium.

The basis of the first peraeopod is relatively shorter than in the male, being

not as long as the rest of the limb; it has an acute apical inner process, reaching forwards beyond middle of length of the ischium which has a similar but shorter distal tooth; the propodus is two-thirds as long again as dactylus, which is almost as long as carpus and has one of its terminal setae conspicuously stouter than the others. The remaining peraeopods are as in the male, the last three pairs having two distal carpal setae, the longer stout, more than twice as long as the other and like the propodal seta reaching to level of tip of dactylus. The latter is long for the genus, being about twice as long as propodus, and its distal half is marked off as a strong claw (fig. 10, prp. 3).

In the uropod the peduncle is about one-fifth as long again as the exopod, but lacks setae on inner margin which is finely serrate in distal third; the exopod is subequal in length to the endopod but has fewer inner spines than in the male, usually three only being present; the terminal spines of this ramus are as in the male; the endopod has no slender spines near proximal end, but the greater part of the length of inner margin is occupied by a series of half a dozen stout spines (fig. 10, urop.); the distal one-fourth of the length of the ramus is unarmed and its apex is simple and acute.

Salient features of the species are the oblique curved carina on the side of the carapace, the character of the uropods and the unusually well-armed distal joints of the second peraeopod (see fig. 10, prp. 2).

CYCLASPIS MOLLIS Hale.

Cyclaspis mollis Hale, 1944, p. 78, fig. 7–8.

Adult male. Integument thin but calcified and brittle.

Carapace plump, relatively conspicuously wider than in members of the *levis* group; it is two-sevenths of the total length of the animal, is less than twice as long as deep and is a little wider than deep; seen from the side the dorsum is only slightly arched from rear to base of ocular lobe and displays some minute irregularities because of pitting of the low, rounded, and not at all sharply defined median longitudinal carina of the back. Ocular lobe, as usual, larger than in female; it is as wide as long, tumid in lateral view and bears nine lenses, three of which are much larger than the others (fig. 11, c.pace.); it has a barely perceptible constriction at base and two of the large lenses extend for about half their diameter behind the lobe. Pseudorostral lobes meeting in front for a distance equal to approximately one-fourth of length of eye-lobe. Antennal notch widely open; antennal angle prominent and subacute.

Exposed pedigerous somites together little more than half as long as carapace; second (first free) somite with dorsum, as viewed from side, sloping obliquely backwards; its anterior pleural portion slightly overlaps the carapace and on the

back there is a distinct median carina; each of the third to fifth somites is transversely carinate at the posterior margin, the narrow strip of strongly calcified integument merging into the subtriangular lateral portion; the upper part of each of these lateral areas is slightly elevated; the anterior pleural portion of the third somite overlaps the second, while the fourth overlaps both third and fifth on the sides; the fifth somite has a median longitudinal carina on the back.

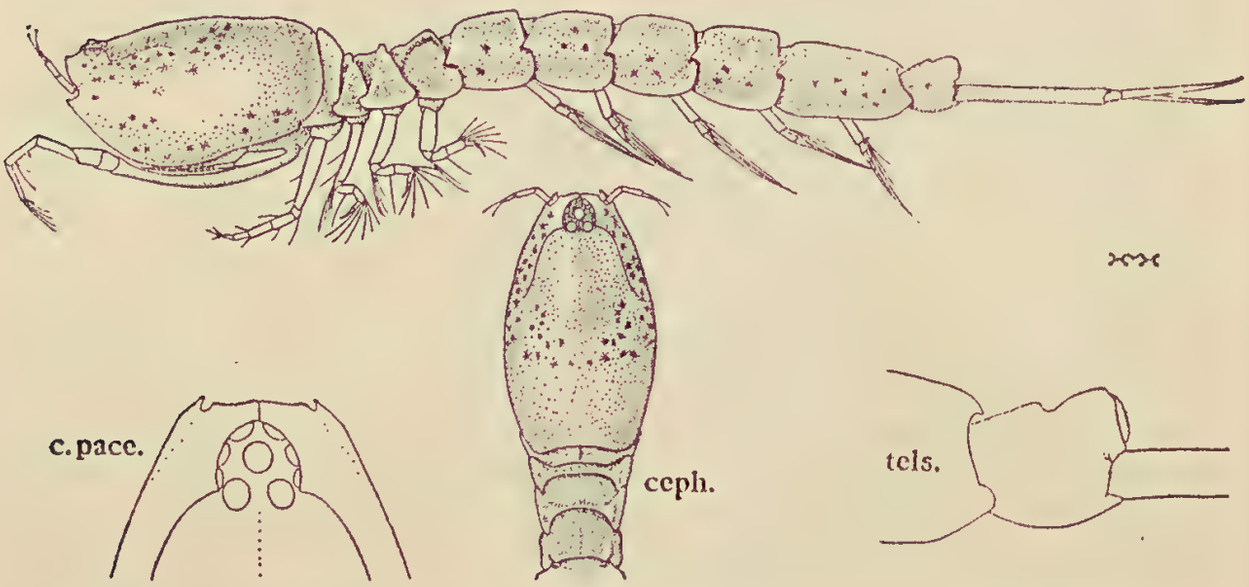

Fig. 11. *Cyclaspis mollis*, adult male; lateral view and (ceph.) cephalothorax from above (× 14; c.pace., anterior portion of carapace from above (× 32); tels., telsonic somite (× 32).

Pleon more than one-fourth as long again as cephalothorax (only about one-twelfth as long again in female) and with the lateral articular pegs strong and subtriangular; there is a clear-cut median dorsal carina on somites one to five and on the fifth this is produced at posterior margin as an acute point (fig. 11, tels.); each of these somites is swollen fore and aft on the sides; the fifth is fully half as long again as the fourth (which is equal in length to each of the preceding somites) and is twice as long as the telsonic somite; the last-named is strongly notched dorsally at middle of length.

Mandible with many spines (about fifteen) in the long row (fig. 12, mand.).

First antenna rather long for the genus, with proportions of joints much as in female; the first segment of peduncle is subequal in length to second and third combined, and the third is only a little longer than second; flagellum two-jointed, the proximal segment more than twice as long as the small distal one.

First peraeopod with basis nearly one-fourth as long again as combined lengths of remaining joints; otherwise as in female. Second to fifth peraeopods as in female.

Peduncle of uropod more than twice as long as telsonic somite and distinctly longer than the slender rami; on the inner edge it bears for the whole length a series of plumose setae and in distal third a second series of slender serrate spines; the exopod of this appendage is barely longer than endopod and is furnished with half a dozen plumose setae which, as in the female, are confined to the proximal fourth of length of inner margin of second joint; inner edge of endopod with

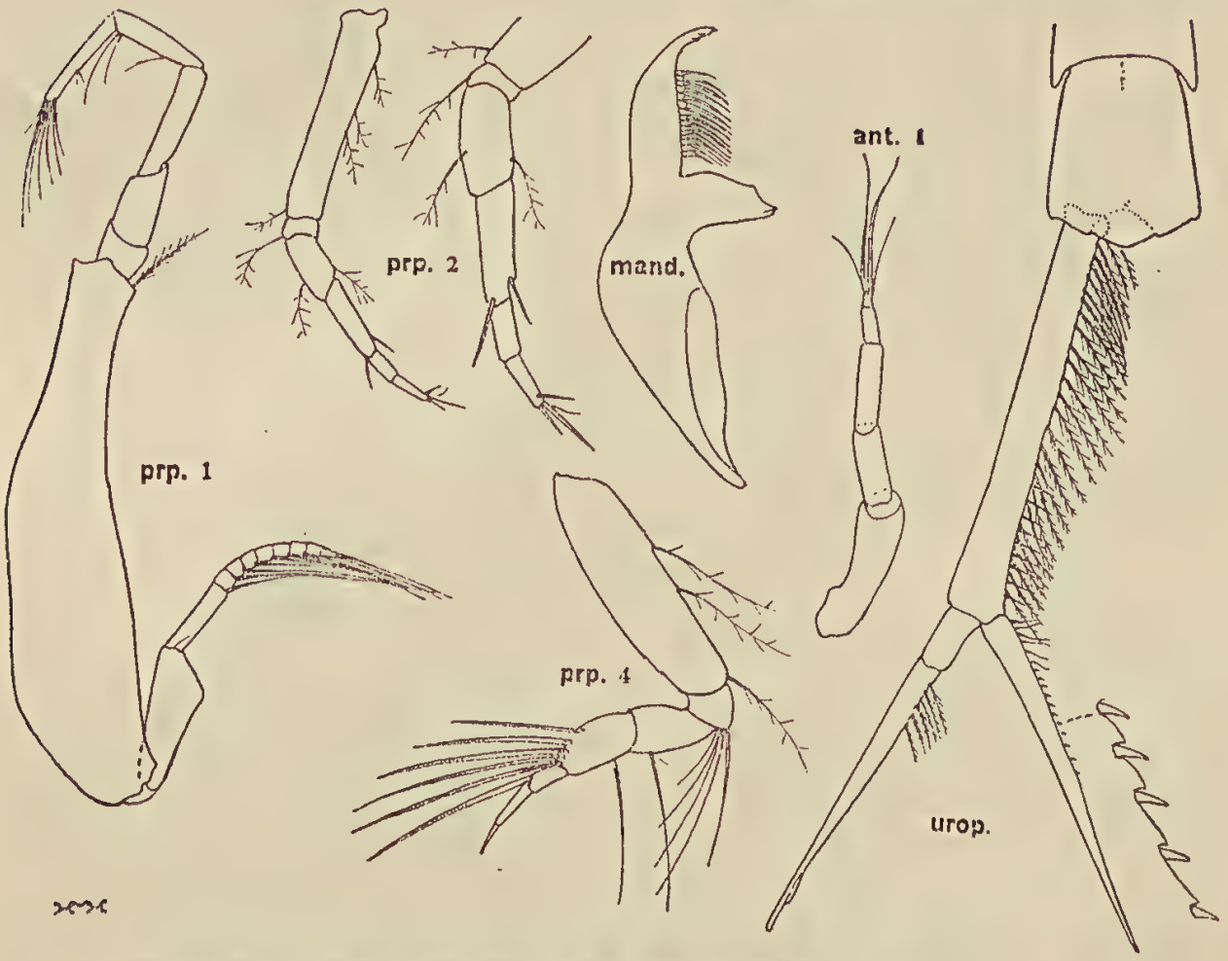

Fig. 12. *Cyclaspis mollis*, adult male; ant. 1, first antenna (× 62); prp. 1, first peraeopod (× 38); prp. 2, second peraeopod (× 38; distal joints, × 62); prp. 4, fourth peraeopod (× 62); urop., telsonic somite and uropod (× 38).

half a dozen very slender serrate spines near proximal end followed by a series of a dozen or thereabouts of tiny spines, leaving the distal half of ramus unarmed; these minute spines, while a trifle larger than those of the female, are similarly inset (cf. fig. 12, urop., and Hale, 1944, fig. 8, G).

Colour white, with small brown chromatophores as shown.

Length 6·5 mm. to 6·75 mm.

Loc. Western Australia: Esperance Bay (A. G. Nicholls, January, 1946); Garden Island, Careening Bay (A. G. Nicholls, November, 1946).

Several males and females with developing marsupium were found amongst submarine light hauls of material made by Dr. Nicholls at the above localities in lat. 32·8° S. and 33·50° S. The species was previously known only from the adult female, taken on the Pacific coast of Australia, in lat. 34° S. The type ovigerous female, like the specimens described above, is well over 6 mm. in length. Examples from Moreton Bay, Queensland, collected by Mr. I. S. R. Munro, are much smaller, an egg-bearing female being only 2·5 mm. long.

Apart from characters given in a general key previously published (Hale, 1944, p. 71), *mollis* has several features enabling it to be easily separated from other species which have well-developed eyes, a plump body and the pseudorostral lobes meeting for an appreciable distance in front of the ocular lobe. The telsonic somite, for instance, is relatively shorter than is usual in the genus, while the first antennae have the second peduncular joint almost as long as the third. Of the related forms, only in *lucida* Hale are the fossorial setae of the posterior peraeopods similarly well developed; in both species there are five on the distal portion of the carpus and the longest, like the propodal seta, extend well beyond the tip of the slender dactylus; in *lucida,* however, the peduncle of the uropod is relatively much longer and the exopod of that appendage bears a terminal mucro.

CYCLASPIS FULGIDA Hale.

Cyclaspis fulgida Hale, 1944, p. 80, fig. 9–10.

Adult male. Integument thin, calcified and brittle. Carapace almost as plump as in *mollis*; it is more than two-seventh of total length of animal; seen from the side the dorsal edge is slightly less arched than in the female. The pseudorostral lobes meet in front of the eye-lobe but for a distance appreciably less than in *mollis.* Antennal notch and tooth as in male of *mollis.*

Exposed pedigerous somites together not much more than half as long as carapace; first free, or second, somite with pleural parts slightly overlapping carapace anteriorly, and with dorsum, as seen from the side, sloping steeply back from the subacute apex.

Pleon one-fourth as long again as cephalothorax (only one-tenth as long again in female) and with articular pegs rather feeble.

Flagellum of second antenna reaching to distal end of the long peduncle of uropod.

First peraeopod with carpus reaching to antennal tooth; basis only one-eighth as long again as combined lengths of remaining joints, and with inner angle, etc., as in female; proportions of distal joints as in female.

Second peraeopod with basis subequal in length to rest of limb, otherwise as in female.

Fossorial legs with setae short, none reaching beyond end of dactylus; there are only two carpal setae, one stout and almost as long as propodus and dactylus together, the other slender and only half as long; propodal seta very stout, a little shorter than dactylus.

Uropods long, the peduncle twice as long as telsonic somite, and a little longer than the subequal tapering rami, both of which have simple apices; proximal two-thirds of inner margin of endopod armed with spines, three or four slender ones near base, followed by fifteen to eighteen short spines.

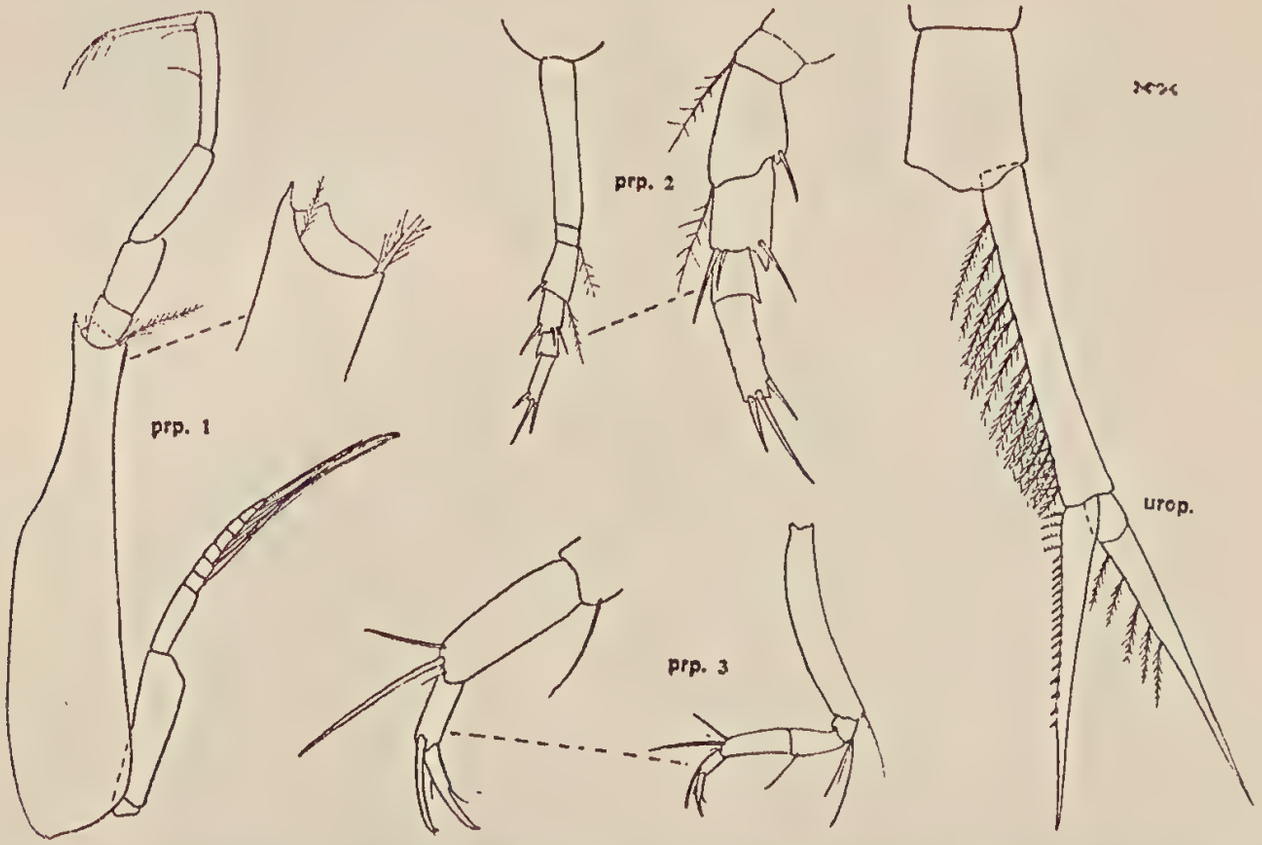

Fig. 13. *Cyclaspis fulgida*, adult male; prp. 1, first peraeopod (× 44; distal end of basis, × 88); prp. 2–3, second and third peraeopods (× 44; distal joints, × 88); urop., telsonic somite and uropod (× 44).

Colour white.

Length 5 mm. to 5·5 mm.

Loc. Western Australia: Garden Island, Careening Bay (A. G. Nicholls, November, 1946). Three males were taken at the same times as the males of *mollis* recorded herein. They are readily separated at a glance by the setal armature of the fossorial limbs.

A couple of ovigerous females, tow-netted by Mr. I. S. R. Munro in Moreton Bay, Queensland, are only 2 mm. and 2·13 mm. in length; otherwise they differ only in trifling details from the 5·75 mm. type ovigerous female from Cronulla,

New South Wales. The rami of the uropods are slightly longer than the peduncle and the longest of the distal dactylar spines is longer than the dactylus itself.

Some species of Cumacea vary in size in different environments; apparently less often do they vary thus in the same situation, for series of adults of a species taken at one place and at the same time are generally approximately equal in size; the factors, possibly many, controlling these differences as yet remain unknown.

CYCLASPIS GLOBOSA Hale.

Cyclaspis globosa Hale, 1944, p. 99, fig. 25–26.

A subadult female, 5 mm. in length, was tow-netted at the surface 40–50 miles offshore in the neighbourhood of Lacepede Bay, South Australia (K. Sheard, lat. 36° 35′ S.; long. 138° 50′ E.; 4 a.m., March, 1939, "Warreen" Station 98, depth at this spot 40 fathoms). The species was known previously only from off New South Wales.

CYCLASPIS CANA Hale.

Cyclaspis cana Hale, 1944, p. 132, fig. 51–52.

A series of males has now been secured near the type locality. The tubercles of the carapace vary very slightly in degree of prominence but two antero-lateral ones and two postero-lateral mark the corners of the "*exsculpta* group" lateral quadrangle; although there is no distinct depressed area on the sides, there may be exceedingly faint indications of an anterior transverse carina and an infero-lateral ridge.

Part of the first peraeopod is missing in the type. In this limb the basis is somewhat longer than remaining joints together, and the propodus is a little longer than merus, which slightly exceeds the dactylus in length; the edges of the joints are serrate, the teeth of the outer edge of merus and carpus, though not large, being more conspicuous than those elsewhere.

CYCLASPIS EXSCULPTA Sars.

Cyclaspis exsculpta Sars, 1887, p. 20, pl i, fig. 24–26; Calman, 1905, pp. 3–4, and 1907, p. 6; Zimmer, 1921, pp. 7–9; Hale, 1944, p. 73.

The above references all discuss the only example previously referred to this species, the type female, which lacks the pleon and terminal segments of the first peraeopods. More than a score of males taken not very far from the type locality of *exsculpta* are here referred to that species because, allowing for the extreme sexual dimorphism which occurs in the adults of some members of the

genus (Hale, 1944, p. 114), they agree with *exsculpta* in differing from the other forms belonging to this section in having longitudinal ridges running forward from a distinct anterior transverse carina to the front of the carapace.

Adult male. Integument highly calcified, with a coarse reticulate surface patterning, which in the more strongly indurated specimens is reduced to a deep pitting rather than a distinctly honeycomb-like sculpture.

Fig. 14. *Cyclaspis exsculpta*, lateral view of adult male (× 14).

Carapace three-tenths of total length of animal, not quite twice as long as deep and width across antero-lateral tubercles not much greater than depth; median dorsal carina almost smooth (faintly pitted) wide and extending from ocular lobe to posterior margin, where it is elevated to form a distinct tumidity; anterior, posterior, dorso-lateral and infero-lateral ridges well defined, although not greatly elevated as in female described by Sars; a ridge runs forward to antennal notch from the low upper antero-lateral tubercle and another from the lower front corner of the lateral quadrangle to front margin of carapace; while these carinae are well marked, the edges of the coarse reticulations form other irregular horizontal ridges anteriorly with certain lighting; that portion of the anterior transverse carina situate below the upper of the frontal horizontal ridges is sharp-edged, and projects slightly forwards; the posterior transverse ridge is not broken on the back, but completely meets the median carina; at the rear of the carapace there is a short obscure dorso-lateral ridge on each side of median carina, terminating at posterior margin but not (or very slightly in a few examples) projecting beyond this margin as in the female described by Sars, or in the female of *supersculpta* of Zimmer; the lower part of carapace is rather sharply inflexed below the lower of the antero-lateral and the infero-lateral ridges. Pseudorostral lobes as in *tribulis*, etc., not produced beyond the narrow ocular lobe, which bears seven distinct corneal lenses. Antennal notch narrow and rather deep; antennal tooth subacute.

First pedigerous somite concealed, second to fourth together barely more than half as long as carapace; second somite not at all elevated dorsally, tumid fore and

aft and with pleural parts overlapping carapace anteriorly; third somite dorsally no longer than second, with pleural parts overlapping second in front; fourth somite (like fifth) longer dorsally than second and third combined, with pleural parts overlapping third in front and fifth posteriorly, and with a dorso-lateral carina on each side; fifth with a median dorsal ridge and a pair of dorso-lateral carinae, projecting to form three small tubercles at posterior margin.

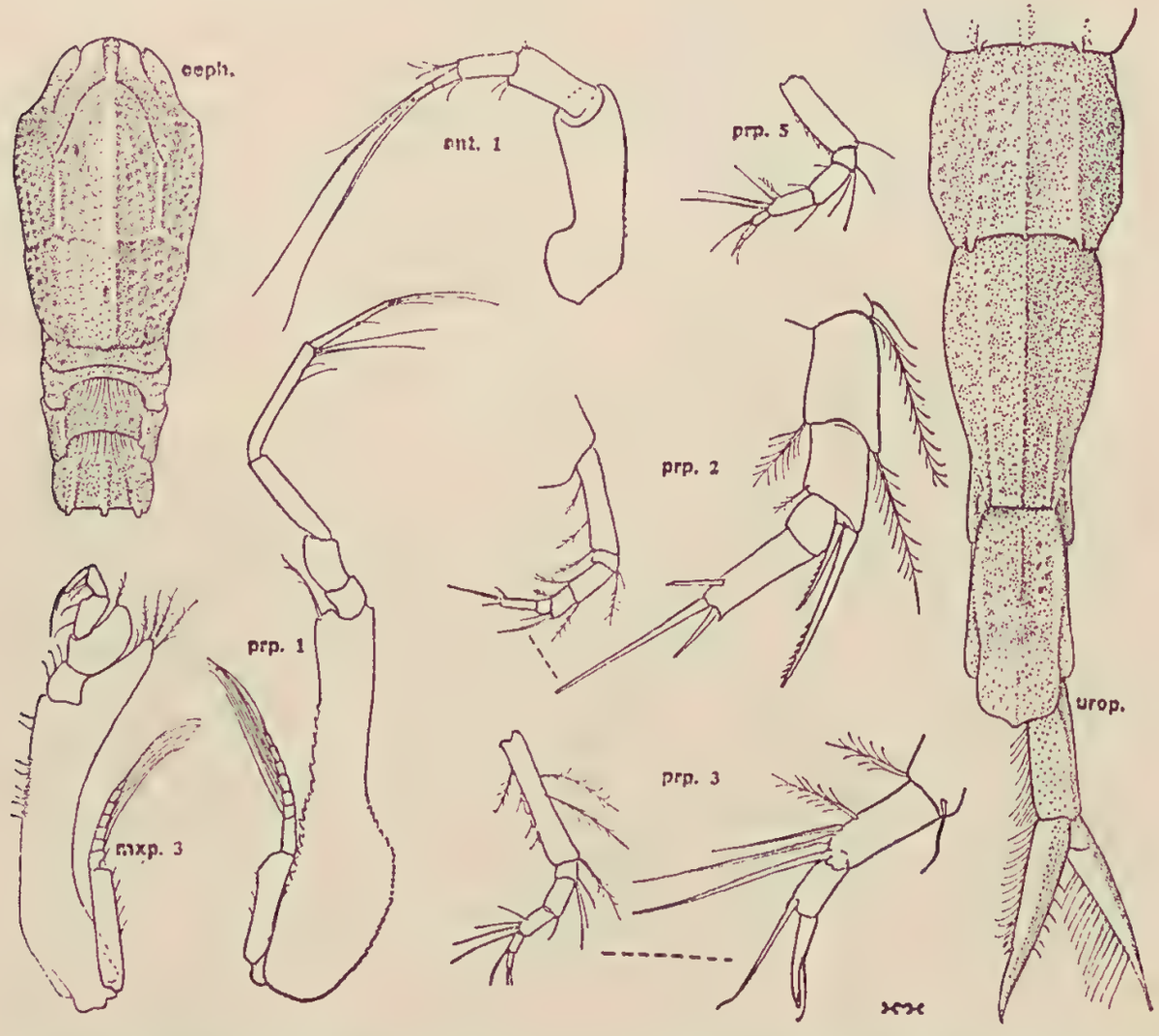

Fig. 15. *Cyclaspis exsculpta*, adult male; ceph., cephalothorax from above (× 14); ant. 1, first antenna (× 76); mxp. and prp., third maxilliped and peracopods (× 27; distal joints of second and third legs, × 76); urop., uropod with fourth, fifth and telsonic somites of pleon (× 27).

First to fifth pleon somites together as long as cephalothorax, each with a low dorso-lateral carina on each side and a feeble median dorsal ridge; on somites one to four the carinae project beyond posterior margins as three tubercles, as distinct on the first as on the last pedigerous somite, less marked in the second to fourth; such projections are not present on the fifth which, however, has the

dorso-lateral carinae more elevated in posterior third than are those of the other somites; the dorsal width of fifth somite is little less than that of fourth anteriorly where it is swollen but it tapers to the rear, where it is only one-third as wide as long; telsonic somite with a feeble dorso-lateral carina on each side and with a sharp elevated median dorsal ridge in anterior half; there is a median dorsal tubercle on the groove marking the fusion between telson and sixth somite, and the telsonic part bears an obsolete median dorsal carina.

First joint of peduncle of first antenna more than half as long again as combined lengths of second and third joints, and second half as long again as third; main flagellum two-jointed, not quite as long as last peduncular segment; accessory lash small, unisegmentate. Second antennal flagellum reaching well beyond end of pleon, sometimes to distal end of rami of uropods.

Third maxilliped with basis not quite two and one-fourth times as long as rest of limb; otherwise much as in male of *tribulis*.

First peraeopod long, when extended with carpus reaching beyond level of end of pseudorostrum; basis subequal in length to rest of limb; propodus one-fifth as long again as merus and dactylus less than two-thirds as long as propodus.

Second peraeopod with basis shorter than rest of limb; distal joints and armature as in allied members of group.

Third to fifth peraeopods also are characteristic of *exsculpta* group.

Peduncle of uropod subquadrate in section, barely two-thirds as long as telsonic somite, two-thirds as long as the equal rami and furnished with a series of plumose setae on inner face; endopod with outer edge jaggedly serrate and with about eight spines and a few smaller but stout spines at second third of length of inner margin, preceded by a double row of "serrate" setae, shorter than those of peduncle, or than the spaced plumose setae on inner edge of exopod.

Colour greyish white.

Length 8 mm. or a little less.

Loc. Queensland: N. Palm Island (I. S. R. Munro, "Reliance" Station, submarine light, 7–9 p.m., October, 1941).

Sars' type was taken "September 8, 1874, at Flinders Passage, 7 fathoms." The locality referred to is just off Cape York, Queensland, and separates Horn Island from Tuesday Islets and Wednesday Island (lat. 10° 35′ S.). There is also a Flinders Passage in the Great Barrier Reef a little to the east of the Palm Islands (lat. 18° 75′ S.) where the males now recorded were taken.

The peduncle of the uropod in these Queensland males is slightly shorter in relation to the telsonic somite than it is in *candida, tribulis* or *usitata*. In this respect these examples approach more nearly to *supersculpta* Zimmer, the sub-adult type female of which is described as having the uropod as a whole not much

longer than the telsonic somite and with the rami twice as long as peduncle (Zimmer, 1921, p. 9, fig. 11). *C. supersculpta,* as mentioned by Zimmer, otherwise shows close affinities with *exsculpta;* it has, for instance, a short dorso-lateral ridge on each side of the median ridge at the hinder end of carapace (similar but longer ridges occur in the otherwise very distinct *persculpta* Calman). Accepting the reference of the above described males to *exsculpta,* then the only noteworthy feature separating *supersculpta* from Sars' species is the absence of defined ridges extending from the anterior transverse carina to the front of the carapace.

One doubt remains regarding the identification of the males from the Palm Islands; as noted, in these the posterior transverse carina joins the median ridge without trace of interruption. The subadult female of *exsculpta* has the hinder transverse crest "divided in the middle line by a distinct notch," in the female of *supersculpta* this carina is interrupted at the middle. In the male of *candida* the posterior ridge fades out on the middle of the back but is in any part very faint and difficult to trace.

The variation which may occur in the sculpture of the carapace of these highly indurated species of *Cyclaspis* is as yet not fully known (Zimmer, 1921, p. 9); it is certain that it alters during growth and may become sexually modified (Hale, 1944, p. 114) and that apparently there may be local variants—see *candida* herein and Hale, 1944, p. 115, fig. 36, A and F.

CYCLASPIS SHEARDI Hale.

Cyclaspis sheardi Hale, 1944, p. 86, fig. 15–16.

The species was described from the adult male only. A single egg-bearing female, from Whalers Bay, Kangaroo Island, South Australia, and taken with many further males by submarine light, is now available. There is no very decided sexual dimorphism in regard to the carapace, as there is in the adults of some members of the *exsculpta* group, but the following comparative details are noted.

Ovigerous female. Carapace deeper and wider than in male and with dorsal edge as seen from the side very slightly more arched; its depth is somewhat more than greatest width and two-thirds of length, which is little more than one-third of total length of animal; a sharp median dorsal ridge runs from apex of ocular lobe to posterior margin and immediately on each side of frontal lobe a faint horizontal carina extends back from anterior margin of pseudorostral lobes, fading out below end of frontal lobe (this ill-defined anterior dorso-lateral fold is present in the male also); in front of branchial regions a V-shaped group of small tubercles diverge; the crassate upper margin of each posterior pit is slightly angular, and the lower edge is bordered by a short horizontal ridge. Pseudo-

rostral lobes meeting in front of ocular lobe to form a very short pseudorostrum. Antennal notch narrowly V-shaped, not so widely open as in male, and antennal angle more acute.

First pedigerous somite exposed on sides but almost concealed on mid-line of dorsum; second not fitting closely against carapace dorsally as in male, but there separated by an interspace, narrowly V-shaped, as seen from the side; although five somites are exposed they are together relatively shorter than in male, being only half as long as carapace.

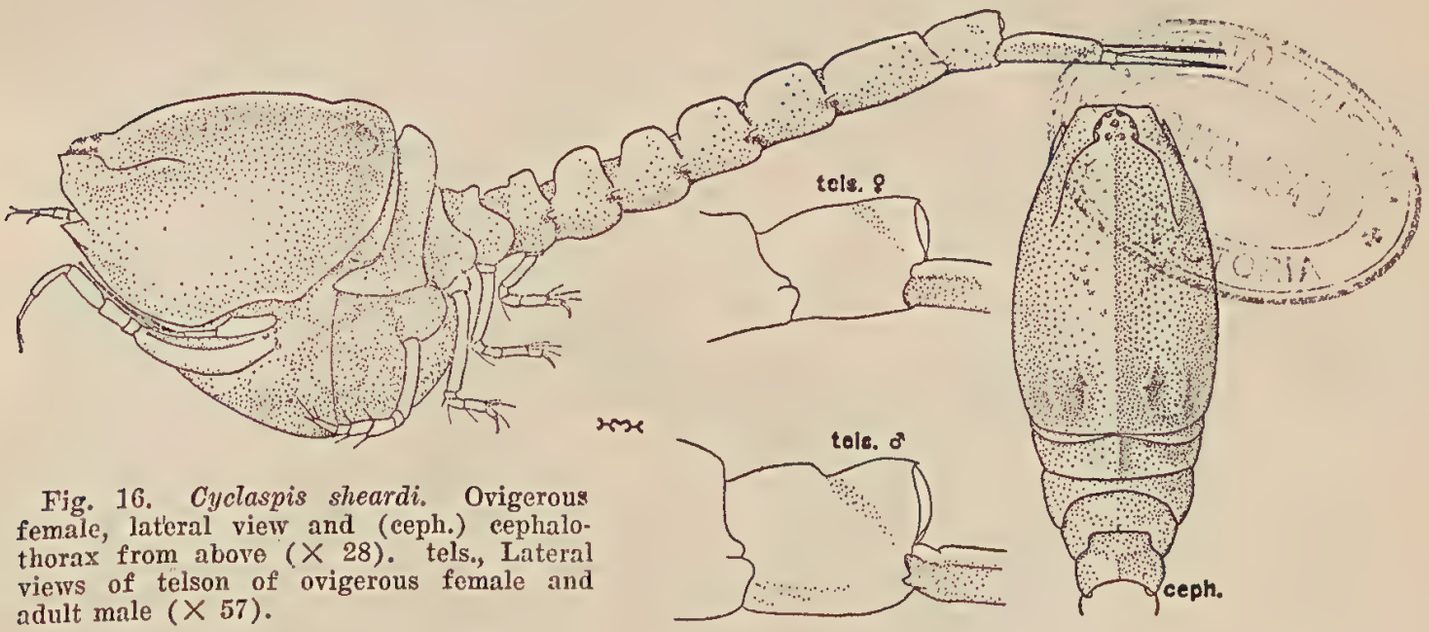

Fig. 16. *Cyclaspis sheardi.* Ovigerous female, lateral view and (ceph.) cephalothorax from above (× 28). tels., Lateral views of telson of ovigerous female and adult male (× 57).

Pleon much more slender than in male, and not longer than cephalothorax; telsonic somite with median dorsal ridge of anterior half less elevated and with telsonic portion not so distinctly marked off (fig. 15, cf. tels. ♂ and ♀).

First peraeopod short, the carpus not reaching to level of antennal angle; basis equal in length to remaining joints together. Remaining peraeopods much as in male.

Peduncle of uropod barely longer than the subequal rami, its inner margin feebly serrate in distal half; inner margin of exopod serrate and with plumose setae, that of endopod more coarsely serrate and with small inset spines.

Colour as in male (stellate spots not shown in fig. 15).

Length 3·6 mm.; ova in greatest diameter, 0·23 mm.

C. sheardi has a wide distribution, occurring off Tasmania, southern Australia and on the eastern coast as far north as lat. 34° S., while some of the material now in hand from Western Australia was taken off the Mary Anne Islands, etc., at

approximately lat. 21° S. and from Garden Island (lat. 32·8° S.). The female described is the only mature example of this sex so far taken.

Two allied species, *rudis* and *brevipes* spp. nov., are described below.

CYCLASPIS RUDIS sp. nov.

Adult male. Integument strongly calcified. Surface of carapace closely studded with flattened, forwardly directed granules.

Carapace less than one-third of total length of animal, slightly depressed and fully three-fourths as long again as deep; the greatest width occurs in anterior third, but is there barely wider than at middle of length, the sides as seen from above being evenly curved, with no prominences; there is, however, a marked

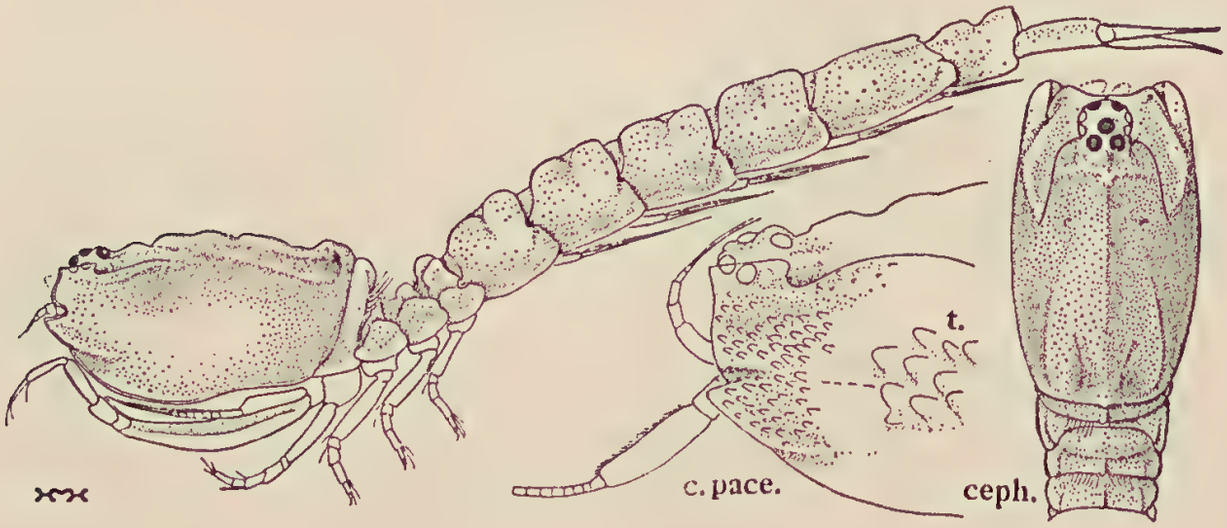

Fig. 17. *Cyclaspis rudis*, type male; lateral view and (ceph.) cephalothorax from above (× 21); c.pace., anterior portion of carapace (× 47; t., tubercles of carapace, × 100).

tumidity on each side of the frontal lobe, and the area inferior to the antennal angle curves prominently outwards; viewed from the side the dorsal profile is irregular owing to a series of elevations of a well-defined median carina, the last prominence being situate at the posterior end; on each side, and below the suture of the frontal lobe, there is a clear cut carina (margining above the aforementioned antero-lateral swelling), and in posterior half of carapace a ridge extends on each side from rear margin to the pits so often present on hinder portion of frontal lobe; between each of these posterior dorso-lateral ridges and the median carina there is a large pit at hinder edge and above this depression a ridge runs forward from the median posterior prominence for a short distance; a very distinct short carina extends back from antennal angle. Pseudorostrum widely truncate, both as seen from above and from the side, the lobes meeting in front

of ocular lobe to form a short but distinct pseudorostrum. Antennal notch widely V-shaped; antennal angle prominent and subacute. Ocular lobe large about as wide as long and with nine distinct corneal lenses, the median five black, the others pale; two of the largest extend beyond hinder end of eye-lobe.

Four pedigerous somites exposed, together only about half as long as carapace; the second leg-bearing somite is fused with the carapace and is rounded dorsally,

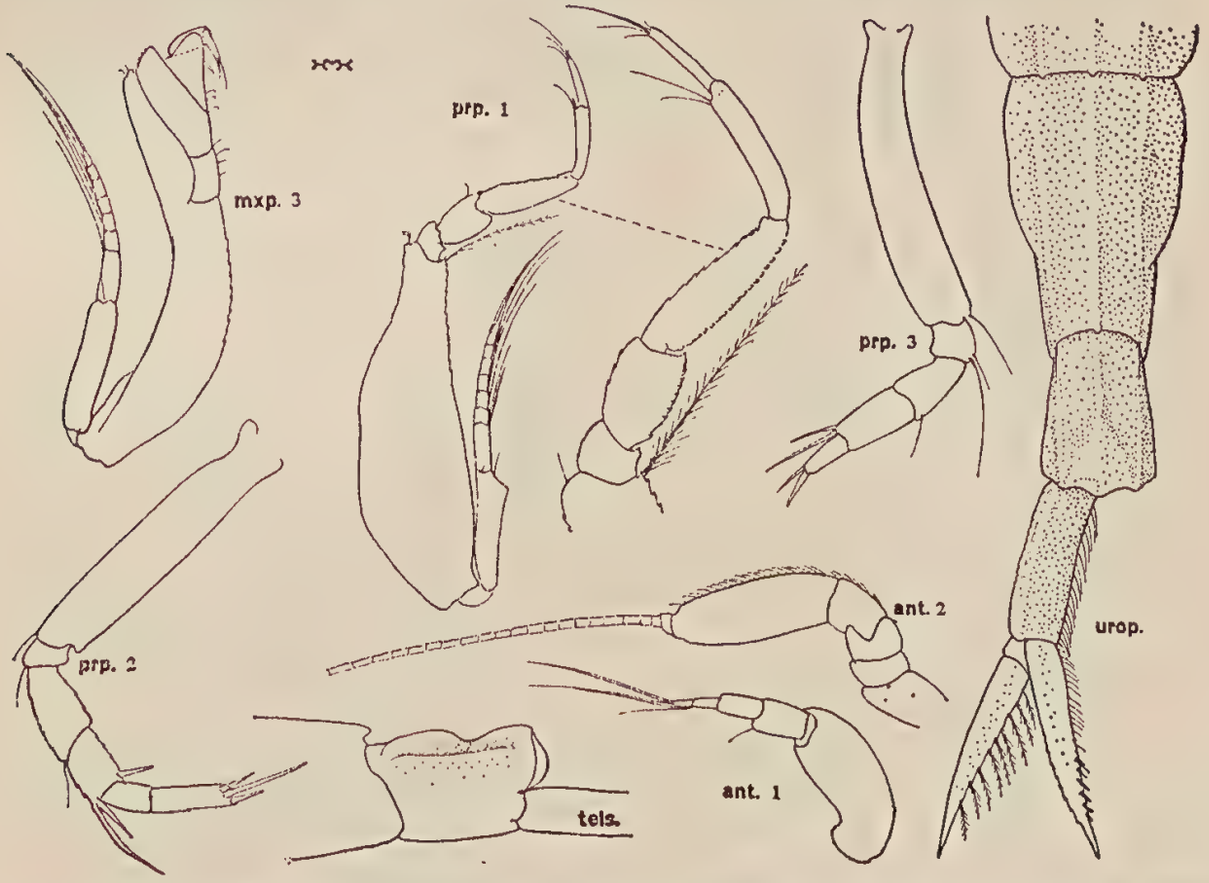

Fig. 18. *Cyclaspis rudis*, type male; ant. 1, first antenna (× 76); ant. 2, second antenna (× 50); mxp. 3 and prp. 1, third maxilliped and first peraeopod (× 40; distal joints of first leg, × 76); urop., uropod with fifth pleon and telonic somites (× 40); tels., telsonic somite from the side (× 40).

but not produced to level of posterior hump of carapace; marginal setae are present on second and fourth somites; second, fourth and fifth with a median dorsal longitudinal carina, projecting posteriorly as a small tubercle; third to fifth with the upper edges of the subtriangular lateral edges elevated and fourth and fifth with a dorso-lateral carina on each side.

Pleon massive, one-third as long again as cephalothorax; the first to fourth somites are tumid fore and aft on the sides and each has a distinct narrow, median dorsal carina and a pair of feeble dorso-lateral ridges, all projecting at posterior margins of somites as insignificant tubercles; the fifth somite tapers to the rear

and is fully half as long again as telsonic somite, is half as long again as greatest width and has a median dorsal carina and well-defined dorso-lateral carinae on each side in posterior half of length; the telsonic somite is about two-thirds as wide as long, has a sharp median ridge on anterior half, a deep incision marking off telsonic part and a dorso-lateral ridge on each side; its hinder margin is sinuate, but medianly is scarcely at all produced.

First joint of peduncle of first antenna as long as remaining peduncular joints and flagellum together; second peduncular segment subequal in length to third; flagellum two-jointed. Second antenna with flagellum reaching a little beyond end of telsonic somite; fifth peduncular joint equal to combined lengths of segments one to four.

Basis of third maxilliped two-thirds as long again as remaining joints together and with outer distal lobe very large, extending to well beyond anterior end of articulation of merus and carpus; outer lobe of merus reaching to level of anterior end of carpus.

First peraeopod, when extended, with carpus attaining level of antennal angle; basis nearly one-fourth as long again as rest of limb; carpus three-fourths as long again as merus, fully one-fourth as long again as propodus and twice as long as dactylus.

Dactylus of second peraeopod shorter than merus, longer than carpus and three-fourths as long again as propodus; its longest distal spine is as long as the joint and its other two much shorter spines are subequal in length; the basis is almost as long as rest of limb.

Basis in third peraeopods longer than rest of limb, about equal to this in fourth and shorter in fifth; carpus in all posterior limbs a little longer than merus and nearly half as long again as propodus; the longer of the two carpal setae, and the propodal seta, do not reach beyond tip of dactylus.

Peduncle of uropod with a dorso-lateral carina; it is equal in length to telsonic somite, little more than two-thirds as long as exopod, and with a fringe of setae on inner edge; endopod barely shorter than exopod, with setae on anterior half, and a few spines on posterior half, of inner margin; exopod with a few inner plumose setae.

Ground colour pale yellow, with anterior and inferior edges of carapace, lower edges of pedigerous and pleon somites, and all carinae, margined with white. Carapace, in addition, with closely placed large spots of dark brown (not shown in figure).

Length 5 mm.

Loc. Western Australia: Off Garden Island (type loc., G. P. Whitley, submarine light, 6.50 p.m.–7.10 p.m., July, 1945); King Sound (G. P. Whitley, ex cutter "Isobel," submarine light, 7 p.m.–7.20 p.m., September, 1945, surface

temperature 21·6° C.); Mary Anne Island, 3½ fathoms (G. P. Whitley, ex cutter "Isobel," submarine light, 7.15 p.m.–7.45 p.m., November, 1945, surface temperature 26° C.). Type in South Australian Museum, Reg. No. C. 2844.

A dozen adults, all males, were secured; the localities range from 17° S. to 32·8° S.

As in *brevipes* sp. nov. the plan of sculpture of the carapace is essentially as in the related *sheardi,* which possesses similar posterior dorsal pits, and antero-lateral tumidities while it has traces of longitudinal dorso-lateral carinae. The proportions of the uropods alone provide for the ready separation of the three species, but other obvious differences are noted in the descriptions.

CYCLASPIS BREVIPES sp. nov.

Adult male. Integument calcified and brittle. Surface of carapace smooth except for very fine reticulate patterning.

Carapace robust, not much more than half as long again as deep; it is less than one-third of total length of animal and is a little narrower than greatest depth; viewed from above the sides are evenly curved for the greater part of their length but anteriorly the areas inferior to the antennal angle are flared outwards; in lateral view the dorsum of the carapace is very slightly wavy and there is no

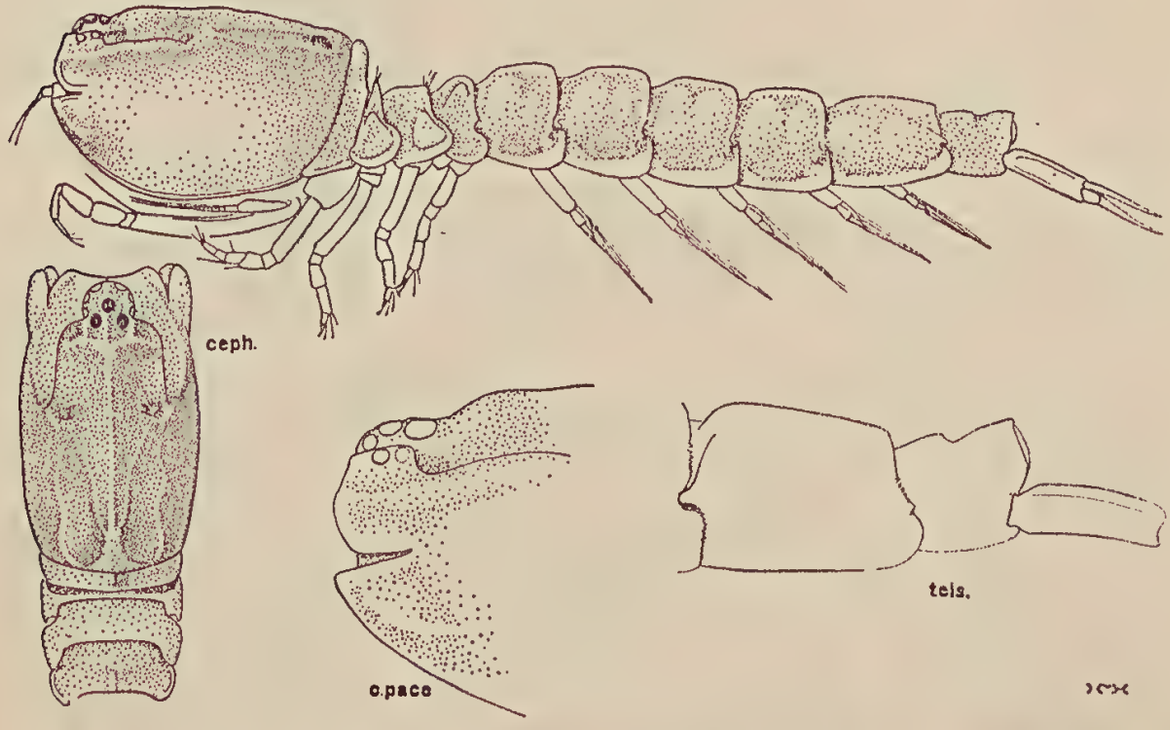

Fig. 19. *Cyclaspis brevipes,* type male; lateral view and (ceph.) cephalothorax from above (× 15); c.pace., anterior portion of carapace (× 28); tels., fifth pleon and telsonic somites with peduncle of uropod (× 25).

marked elevation at the rear, although the strong median carina is here swollen; there is a pair of posterior dorsal pits as in *rudis* and carinae which are disposed much as in that species; on the frontal lobe there is a transverse ridge (feebly developed in *rudis*) immediately behind the ocular lobe. Pseudorostrum broadly truncate, the lobes meeting for a short distance in front of ocular lobe, which is much as in *rudis*. Antennal notch broadly V-shaped but extending inwards as a closed slit.

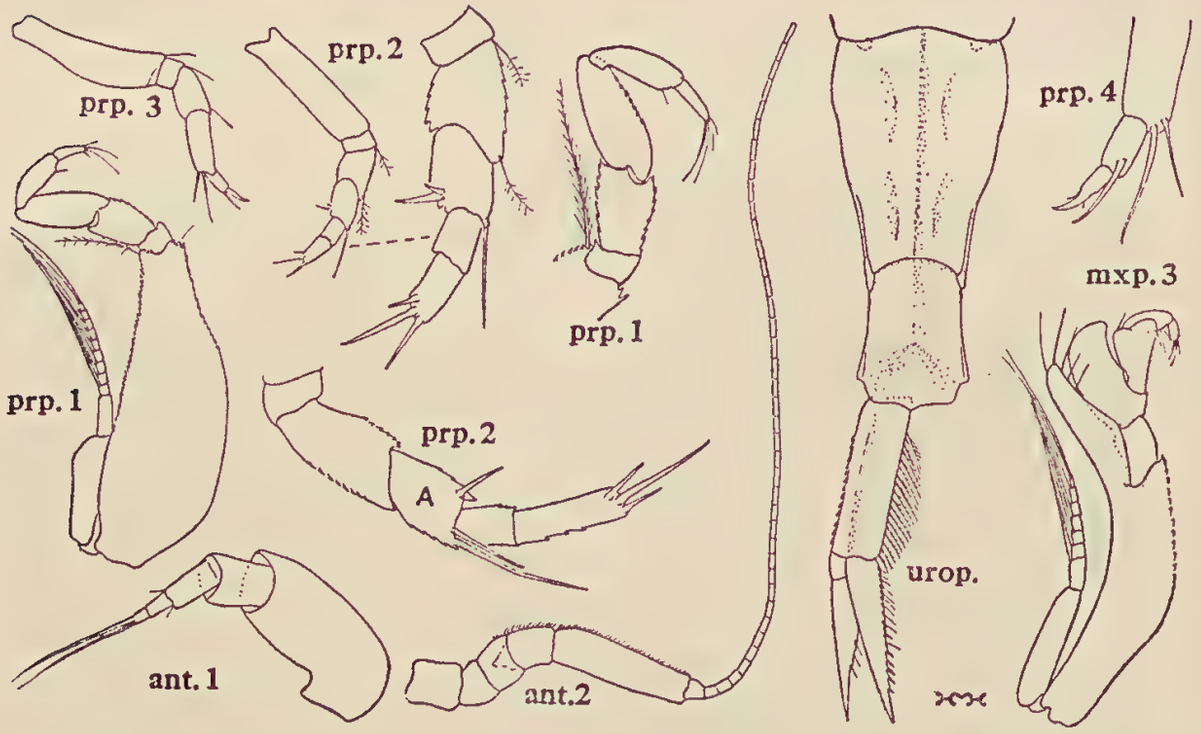

Fig. 20. *Cyclaspis brevipes*, adult male; ant. 1, first antenna (× 105); ant. 2, second antenna, distal portion of flagellum omitted (× 47); mxp. 3, third maxilliped (× 47); prp. 1, first peraeopod (× 47; distal joints, × 66); prp. 2–4, second to fourth peraeopods (× 47; distal joints of second and fourth, × 105); urop., uropod with fifth pleon and telsonic somites (× 47). A, Distal joints of second peraeopod of adult male of *C. rudis* for comparison.

The four exposed pedigerous somites are together more than half as long as carapace; second and fourth each with a short median dorsal carina; other somites smooth on dorsum.

Pleon robust, only one-fifth as long again as cephalothorax; first to fourth somites each with a strong median carina on back, but no dorso-lateral ridges; fifth somite tapering to the rear, half as long again as telsonic somite, more than half as long again as greatest width and with a strong median dorsal carina. Telsonic somite broadest at the rear (where it is three-fourths as wide as long) with a median ridge on proximal half of back, a distinct dorsal notch but no dorso-lateral carinae.

Antennae and maxilliped much as in *rudis* (see fig. 19 mxp. and ant.).

First peraeopod short and stout, the carpus of the extended limb not reaching to antennal angle; basis more than one-fourth as long again as rest of limb and with greatest breadth equal to one-third of its length; carpus less than three-fourths as long as merus, nearly half as long again as propodus and two and three-fourths times as long as dactylus.

Dactylus of second peraeopod little more than half as long as merus, shorter than carpus and barely longer than propodus; its longest distal spine is longer than the joint and the other two distal spines are unequal in length; the basis is as long as remaining joints together.

Basis of third peraeopod equal in length to rest of limb, that of fourth and fifth pairs shorter; carpus of posterior legs longer than merus and twice as long as propodus; setae as in *rudis*.

Peduncle of uropod with dorso-lateral carina and with plumose setae on inner margin; it is equal in length to the telsonic somite and to the exopod, which has half a dozen inner plumose setae; endopod equal in length to exopod, with ten slender spines in proximal half and six shorter and stronger spines in distal half.

Colour dark purplish brown, the front and inferior portions of carapace, and lower parts of pedigerous and pleon somites, margined with pale yellow.

Length 4 mm.

Loc. Western Australia: Shark Bay, west of Cape Peron, 3 fathoms (G. P. Whitley, ex cutter "Isobel," submarine light, 8 p.m.–8.20 p.m., August, 1945, surface temperature 18·55° C.; off Onslow, Airlie Island, 3 fathoms, on rock, coral and sand bottom (type loc., G. P. Whitley, ex cutter "Isobel," submarine light, 7.40 p.m.–8 p.m., September, 1945, surface temperature 21·6° C. Type in South Australian Museum, Reg. No. C. 3014.

A ridge corresponding to the anterior transverse carina of the *exsculpta* group, runs across the frontal lobe just behind the eye-lobe and connects the antero-lateral tumidities. This carina, more feebly developed, is present in *rudis* also. The whole sculpture plan is as in *rudis*, but *brevipes* differs in having the carapace relatively deeper and (apart from the ridges and pits) smooth instead of granulate, while its dorsum is not markedly irregular; further, all the pleon somites are relatively shorter, the first and second peraeopods are shorter, with the joints of different proportions, and the uropods are distinctly shorter, with the rami equal in length to the peduncle.

As noted under *rudis*, this species is allied to *sheardi*. *C. simula* Hale (1944, p. 130, fig. 49–50) also has some features in common with *brevipes* and, similarly, has the distal joints of the first peraeopods short; the last feature may be due to immaturity, *simula* being known only from the young male. In the latter

the peduncle of the uropod is one-fourth as long again as telsonic somite and one-third as long again as the rami, and it may be assumed that the whole appendage is relatively longer in the adult male.

CYCLASPIS MJOBERGI Zimmer.

Cyclaspis mjobergi Zimmer, 1921, p. 11, fig. 14–16; Hale, 1944, p. 88, fig. 17–18 (male).

? Cyclaspis usitata Hale, 1932, p. 549, fig. 1, and 1944, p. 122, fig. 43 (female).

There is now an opportunity to compare with the material recorded below as *candida* South Australian males previously referred to *mjobergi* as well as a series of males secured at three localities in Shark Bay, Western Australia (G. P. Whitley, September–November, 1945) and at Garden Island, Western Australia (A. G. Nicholls, November, 1946); the western males here referred to *mjobergi* are of the same size as those from the south, being thus considerably smaller than Zimmer's types, which were taken off Cape Jaubert, north-western Australia.

There is no doubt that *candida* and *mjobergi* are very closely allied—the male of the last-named differing only (1) as pointed out by Zimmer in having the dactylus of the first leg longer in relation to the propodus of that limb (see fig. 20, A and B, prp. 1); (2) in having the ridges so generally characteristic of the *exsculpta* group obsolete. Nevertheless, its place in this group is undoubted, although in my key (Hale, 1944, p. 71) the absence of ridges arbitrarily throws it with the *levis* group (see also Hale, 1944, pp. 64 and 66).

Although the *exsculpta* type of ridging is absent there is, in some of the examples from South Australia, some slight suggestion of the sculpture. This consists, in the first place of the tumidity, previously noted, below the frontal lobe and occupying the site of the large antero-lateral tubercles where typically developed; secondly, the dorsum of the carapace is not always so completely smoothly arched as in the specimen figured previously, and there may be present a minute median dorsal tubercle, in the same position as that formed by the first transverse ridge of some other species of the *exsculpta* group (fig. 20, A). The surface pitting as described by Zimmer seems to be merely a modification of the coarse honeycomb pattern; this surface sculpturing varies in the males of *exsculpta* where a thickening of the walls of the reticulations may greatly reduce the size of the enclosed area.

The males from Shark Bay, Western Australia, have the dactylus of the first peraeopod three-fourths to four-fifths as long as the propodus of that limb and the peduncle of the uropod while a little longer than in the South Australian examples is nevertheless slightly shorter than the rami; it seems probable that the tips of the latter were damaged in the types.

Males from Garden Island, 9mm. in length, have the peduncle of the uropod shorter than the rami. Although the proportions of the terminal joints of the first peraeopods are as in the southern examples, they are relatively much more elongate, the combined lengths of these joints (ischium to dactylus) being

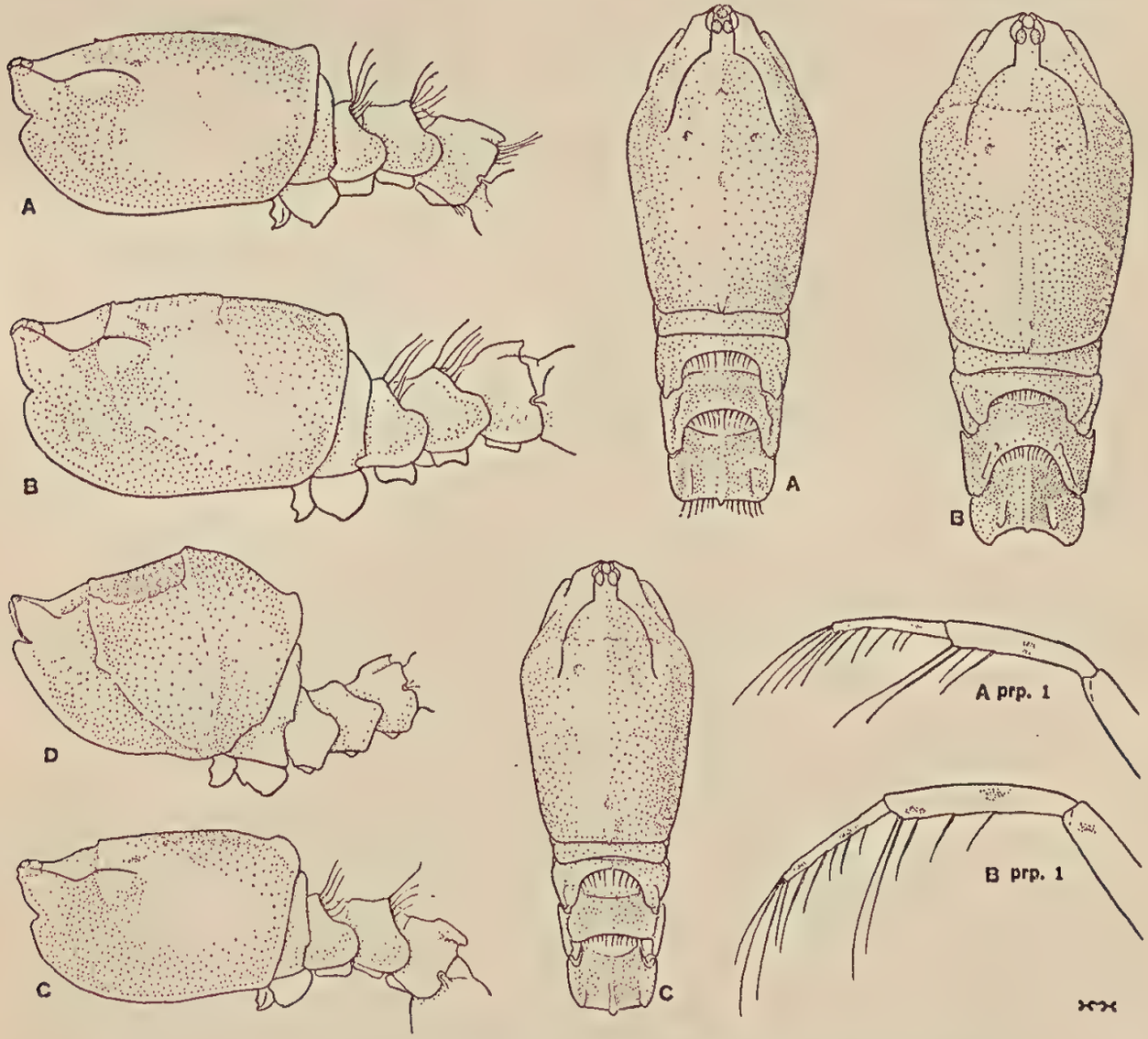

Fig. 21. A, *Cyclaspis mjobergi*, adult male from South Australia; lateral and dorsal views of cephalothorax (× 16); prp. 1, distal joints of first peraeopod (× 45). B, *C. candida*, adult male from New South Wales; lateral and dorsal views of cephalothorax (× 16); prp. 1, distal joints of first peraeopod (× 45). C, Lateral and dorsal views of cephalothorax of adult male of *C. candida* from Queensland (× 16). D, Lateral view of cephalothorax of non-ovigerous female of *C. candida* from Queensland (× 16).

equal to the length of the basis, whereas in South Australian specimens the last-named is half as long again in relation to the rest of the limb.

As mentioned below, under *candida*, ovigerous females described from South Australia as *usitata* differ from a very similar adult female taken in Shark Bay,

Western Australia, only in having the dactylus of the first peracopod a little longer in relation to the propodus, a difference found between the males of *candida* and *mjobergi*. Thus, if the two species are really separable it would appear that *usitata* is the female of *mjobergi*. Many adult males of the last-named species and a large number of ovigerous females of *usitata* were taken on the same night but in separate hauls at Brighton, South Australia, in October, 1941.

CYCLASPIS CANDIDA Zimmer.

Cyclaspis candida Zimmer, 1921, p. 9, fig. 12–13.

Adult male, New South Wales. A series of examples nearly 8 mm. in total length and taken from Cronulla (H. M. Hale and K. Sheard, submarine light, 8 feet on sand, January, 1944) are referred to this species. Although the size is considerably smaller than Zimmer's type male from North-Western Australia (12·6 mm.) they exhibit no significant character by which they can be separated. As stated in the original description the sculpture of the carapace is faint; the first transverse ridge is, however, distinct on the back and the posterior transverse carina is traceable on the dorsum (where it is interrupted medianly) and for a short distance on the sides of most examples (fig. 20, B).

Zimmer describes the peduncle of the uropod of the type as being almost as long as the rami; in the males now recorded it is fully two-thirds as long as the rami.

The dactylus of the first peracopod, as in the type, is two-thirds as long as the propodus.

Adult male, Queensland. A goodly number of males were found stranded at the water's edge in the Noosa River (an inlet of the sea) by Mr. I. S. R. Munro, June, 1944, and in September, 1945, the same collector secured by trawling in the same locality a single adult male and an immature male. These males are only 6·5 mm. in length, thus being still smaller than the New South Wales specimens and barely more than half as long as the type. The appendages are as in the other material except that the peduncle of the uropod is a trifle shorter in relation to the rami. In some examples, however, the sculpture of the carapace is still less apparent. The anterior transverse carina, with its tiny median dorsal projection, is fairly easily made out with careful lighting, but there is no trace of the second transverse carina (fig. 20, C) or at most the feeblest indications of such ridge.

Non-ovigerous female, Queensland. Stranded with the males just noted were a couple of subadult females of about the same size presumed to belong to the same species (fig. 20, D). These resemble the subadult female previously figured

from New South Wales (Hale, 1944, fig. 44) as *usitata;* incidentally, immature males from New South Wales and the aforementioned subadult Queensland male are about 7 mm. in length and have the form just as in these females, with the ridges of the carapace distinct but with the second pedigerous somite not at all elevated dorsally. In *tribulis* the sculpture of the carapace is strong in the female and young male but is partially obliterated in the adult male.

Adult male, Western Australia. A dozen males taken in Shark Bay (Broadhurst Bight, G. P. Whitley, November, 1945) are of the same size (8 mm.) as the aforementioned New South Wales males, which they otherwise closely resemble.

Ovigerous female, Western Australia. An ovigerous female, 6 mm. in length and taken with immature females and a young male in Shark Bay (Monkeymia, 2 fathoms, G. P. Whitley, November, 1945), is referred here; it is very close to the South Australian adult females previously described as *usitata* (Hale, 1932, p. 549, fig. 1, and 1944, p. 122, fig. 43), the only appreciable difference being that the dactylus of the first peraeopod is a little shorter in relation to the propodus, being less than two-thirds as long as the latter instead of fully two-thirds as long as it.

REFERENCES CITED.

Calman, W. T. (1904): "Report on the Cumacea collected by Prof. Herdman, at Ceylon, in 1902." *Ceylon Pearl Oyster Fish.* 1904, Supp. Rep., xii, pp. 159–180, pl. i–v.

Calman, W. T. (1905): "The Cumacea of the Siboga Expedition." *Siboga. Exped.*, Mon., xxvi, pp. 1–23, pl. i–ii, text fig. 1–4.

Calman, W. T. (1907): "On New or Rare Crustacea of the Order Cumacea from the Collection of the Copenhagen Museum. Part I. The Families Bodotriidae, Vauntompsoniidae, and Leuconidae." *Trans. Zool. Soc.*, xviii, pp. 1–58, pl. i–ix.

Calman, W. T. (1917): *Brit. Antarc.* ("*Terra Nova*") *Exped.*, 1910. *Nat. Hist. Rep. Zool.*, iii, part iv, pp. 145–156, fig. 4–9.

Hale, Herbert M. (1928): "Australian Cumacea." *Trans. Roy. Soc., S. Aust.*, lii, pp. 31–48, fig. 1–17.

Hale, Herbert M. (1932): "A Cumacean New to South Australia." *Rec. S. Aust. Mus.*, iv. pp. 549–550, fig. 1.

Hale, Herbert M. (1936): "Three New Cumacea from South Australia." *Rec. S. Aust. Mus.*, v, pp. 395–403, fig. 1–6.

Hale, Herbert M. (1936a): "Cumacea from a South Australian Reef." *Rec. S. Aust. Mus.*, v, pp. 404–438, fig. 1–23.

Hale, Herbert M. (1937) : "Further Notes on the Cumacea of South Australian Reefs." *Rec. S. Aust. Mus.*, vi, pp. 61–74, fig. 1–9.

Hale, Herbert M. (1944) : "The Genus *Cyclaspis*." *Rec. S. Aust. Mus.*, viii, pp. 63–142, fig. 1–60.

Hale, Herbert M. (1946) : "The Family Diastylidae, Part 2." *Rec. S. Aust. Mus.*, viii, pp. 357–444, fig. 1–60.

Sars, G. O. (1887) : *Rep. Sci. Res. "Challenger,"* Zool. xix, part lv, "Report on the Cumacea," p. 1–73, pl. i–xi.

Zimmer, Carl (1921) : Results of Dr. Mjoberg's Swedish Scientific Expedition to Australia, 1910–13, xxvi. *Cumaceen. Kongl. Svenska Vet.-Akad. Hand.*, lxi (No. 7), pp. 1–13, fig. 1–16.

ILLUSTRATIONS AND DESCRIPTIONS OF SOUTH AUSTRALIAN FUNGI

I. *AGARICUS* AND *CORTINARIUS* WITH SPECIAL REFERENCE TO ANTIBIOTIC SPECIES

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Plates i–iii.

Since the discovery of penicillin and its allies, numerous workers have shown that the production of substances antagonistic to the growth of micro-organisms is not limited to mould fungi alone, but seems to be a very widespread characteristic of many members of the plant kingdom. The substances active in producing such effects may be very diverse in constitution, and, in fact, the majority of them still await exact chemical identification.

In England, Wilkins and Harris (1944) have shown that extracts of the sporophores of many of the larger Basidiomycetes may be active against the representative bacteria, *Escherichia* (*Bacterium*) *coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* (*pyocyanea*), and of some seven hundred species tested by them during the seasons of 1942–3, about seventy proved to be strongly active, and about a hundred weakly so. In Victoria over two hundred species were examined by Mathieson (1946) who found about forty to be active against *Staph. aureus* and twenty to be active against both *Staph. aureus* and *Esch. coli*. In South Australia, Atkinson (1946) reported only five active species in over two hundred tested.

This paper has arisen from a consideration of the identification of some of the groups of the higher fungi which have been tested for antibiotic properties and have given positive results. Mathieson (1946) has indicated that the systematics of these groups leave much to be desired, and it is hoped that this paper will be the first of a series investigating some of the Australian representatives. In it a new variety of *Agaricus* and nine new species of *Cortinarius* are described along with one new name and notes on three other species. All the accompanying plates have been prepared from watercolours drawn by Miss Gwen D. Walsh of the South Australian Museum, and to whom our thanks are due.

The results of Wilkins and Harris (1944) and Mathieson (1946) suggest that the occurrence of antibiotic properties of the extracts of basidiomycete sporophores is not confined exclusively to certain groups, but rather seems to be

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scattered more or less indiscriminately through many of the genera. In South Australia workers at the Institute of Medical and Veterinary Science have reported many fewer positive results (Atkinson, 1946) and it has seemed that activity has been restricted to comparatively well-defined groups, notably the genera *Agaricus* L. ex. Fr. and *Cortinarius* (Pers. ex Fr.) Gray. Nevertheless, it has been quite a striking feature that several species reported as active by Wilkins and Harris (1944) in England have been reported as inactive by Mathieson (1946) and Atkinson in Australia, e.g. *Agaricus arvensis* (Schaeff.) Fr. and *Polystictus versicolor* (L.) Fr., while a large number of the species reported as active by Mathieson (1946) in Victoria have been found to be inactive in South Australia by Atkinson and co-workers, e.g. *Cortinarius castaneo-fulvus* Clel., *Trametes cinnabarina* (Jacq.) Fr., *Clitopilus subfrumentaceus* Clel. and *Mycena epipterygia* Scop., so that at present one is in quandary whether to explain such discrepancies as due to variations amongst strains of the one species of fungus, to the production of antibiotic substances being dependent upon locality and environment, to distinct species having been used but identified as the one species and so named, or to a reflection of minor differences between the techniques of the workers testing them and the strains of bacteria they have employed.

A recent paper by Atkinson (1946) has dealt with the properties of extracts of two of the fungi provisionally identified by one of us (J.B.C.) as *Cortinarius rotundisporus* Clel. et Cheel and *Psalliota xanthoderma* Genev. In the light of further examination of collected material it seems that each should be re-named.

In accordance with Ainsworth and Bisby (1943) we shall adopt the generic name *Agaricus* L. ex Fr. rather than *Psalliota* (Fr.) Quel. as used by Rea (1922) and Cleland (1934) in reference to the genus which includes the common field and horse mushrooms, since the former has been advocated by the British Mycological Society (1940). In this genus Wilkins and Harris (1944) found extracts of *A. arvensis* (Schaeff.) Fr. and two varieties of *A. xanthodermus* Genev. to be active. In Victoria, Mathieson (1946) has found both *A. arvensis* (Schaeff.) Fr. and *A. xanthodermus* Genev. to be inactive, while Atkinson has found the former to be inactive, while a fungus closely resembling the latter to be uniformly and consistently active against *Staph. aureus, Bact. typhosum*, the vole tubercle bacillus and *Mycobacterium phlei.*

Cleland (1934) believed that the fungus closely resembling the horse mushroom but showing yellow stains on bruising, and found by him in Australia, to be apparently identical with the Continental *A. xanthodermus* Genev. and so he recorded it accordingly. The yellow staining phenomenon of this mushroom is so characteristic, that in a genus such as *Agaricus* L. ex Fr. with some sixty temperate species, this property is sufficiently well marked to form the basis of the

species determination. Until recently it has been believed that the Southern Hemisphere species is identical with the northern type, but compared to this plant as figured by Ramsbottom (1945), the plant which we have been collecting is usually shorter and stouter in the stem, smaller in overall dimensions and of slightly different growth habit, coupled with the fact that numerous records are available of persons eating large numbers of this fungus without feeling the slightest ill effects in contrast to its European record. Therefore, we feel that possibly the South Australian plant may not be identical with the type description and so suggest segregating it as a new variety for which the name *Agaricus xanthodermus* var. *antibioticus* var. nov. is proposed. It is also pointed out that this new variety is closely related to *A. arvensis* var. *fragrans* Clel. and Cheel described and figured by Cleland and Cheel (1918) and which differs from it in possessing a decidedly fragrant smell, so that it indicates that the new variety it closely related to both *A. arvensis* (Schaeff.) Fr. and *A. xanthodermus* Genev.

Recently Wilkins (1947) has indicated that irregular positive results for *A. arvensis* (Schaeff.) Fr. previously reported by Wilkins and Harris (1944) are almost certainly due to mistaken identification of individuals of *A. xanthodermus* Genev. Furthermore, he suggests that the *Psalliota xanthoderma* of Atkinson (1946), the *Psalliota* sp. of Mathieson (1946) and the English collections of *A. xanthodermus* may be identical, but it seems doubtful at least whether the South Australian and the Victorian plants are sufficiently alike to be so. Below is a description of the new variety:

AGARICUS XANTHODERMUS var. ANTIBIOTICUS var. nov.

Pileus at first 4 cm. in diameter with a flat top (4 cm.) and nearly vertical sides (2·2 cm. high), then to 6 cm., convex, whitish with a tendency to fibrillose scales, sometimes finely flocculose (in the watercolour covered with dirt so as to appear brownish), turning mustard-pickle colour when rubbed under the tap to remove the dirt. Closed with the veil. Veil rather double at the attachment to the stem, white turning yellow when rubbed, ring rather distant. Gills quite free, 7 mm. deep, at first livid pink (near Ecru Drab, pl. xlvi[2]), never fresh pink, then dingy purplish. Stem 4 to 5 cm. high, stout, equal above (1·5 to 2 cm.), conical below passing into the root, whitish with Deep Chrome (pl. iii) stains at base of stem, finely fibrillose, solid. Flesh turning yellow. Smell rather strong. Spores fuscous, rather variable in shape, broader at one end, 7·5 to 9 × 5·5μ some 5·5 × 3·7μ. Near Adelaide, August, 1946. Tested at the Institute of Medical and Veterinary Science, Adelaide, over the last three years this species, or at least

[2]These Roman figures refer to the plates in Ridgway's Color Standards and Color Nomenclature, Washington, 1912.

this variety of it, has been consistently strongly antibiotic to *Staph. aureus*, *Eberthella typhosa*, the vole tubercle bacillus and *Mycobacterium phlei*. If this antibiotic quality does not pertain to the type species, we would apply the term *antibioticus* to this as a definite variety. [See Atkinson (1946) for properties of extracts.]

Varietas cum qualitatibus perantibioticis contra *Mycobacterium* sp. *Staphylococcum aureum* et *Eberthellam typhosam*.

CORTINARIUS.

The genus *Cortinarius* (Pers. ex Fr.) S. F. Gray is the largest genus of the Agaricales, having at least some four hundred recognized species, especially in the Northern Temperate zone. The genus is a very well-defined one, but according to Fries (1836–8) "although it is a great natural group, the species are so intimately related among themselves that to distinguish the separate ones is almost to be despaired of." In England at least two hundred are known, but for Australia Cooke (1892) lists only seven, while Cleland (1928) records fourteen and later (1934) some twenty-six, of which all but four are new, so that in all not more than about thirty to forty separate Australian collections have been named.

While the generic characters are so well-marked, there are so many closely related species giving a whole graded series from one extreme feature to another, that the taxonomy within the genus is extremely difficult, since it is so difficult to ascertain where one species ends and another begins. One therefore has to choose between either the tendency to recognize a few species exhibiting considerable variations or to recognize a larger number of species of reasonably constant morphology. It is difficult to say which is the wiser until we are able to assess the species concept within this genus upon a more natural basis and have some understanding of the effect of ecological factors upon morphological features and also some knowledge of the genetics of the group.

The genus was divided by Fries into some six sub-genera, a system which has remained intact with most present day authors. A key to these as used by Lange (1938) is as follows:

I. *Phlegmacium*. Fleshy, generally large species with a more or less viscid cap and a dry stem.
   (i.) Scauri. Stem with a distinct often marginate bulb.
   (ii.) Cliduchi–Elastici. Stem club-shaped or cylindrical, without marginate bulb.

II. *Myxacium*. Both cap and stem more or less viscid.
   (i.) Colliniti. Stem peronate, slimy. Spores pruniform, large ($>10\mu$).
   (ii.) Delibuti. Stem merely viscid. Spores smaller ($<9\mu$).

III. *Inoloma.* Cap and stem dry, generally squamulose or somewhat fibrillose. Stem stout.

(i.) Pallido-violacei. Whole fruiting body whitish or flushed with lilac or bluish.

(ii.) Olivaceo-aurati. Cap and stem with some tinges of olive, yellow, ochre or red.

IV. *Dermocybe.* Cap dry (not hygrophanous), subfibrillose or subsquamulose. Stem slender.

(i.) Anomali. Gills olive, bluish or pallid.

(ii.) Nitidi. Gills brilliant yellow to deep blood red or liver brown.

V. *Telamonia.* Expallent or hygrophanous. Stem peronate or annulate by remnants of universal veil.

(i) Carnosi. Rather fleshy species (only sub-hygrophanous) with a somewhat bulbous stem. Spores often rather large ($>9\mu$).

(ii.) Submembranacei. Slightly fleshy, hygrophanous species with a rather slender stem. Spores generally rather small ($<9\mu$).

VI. *Hydrocybe.* Hygrophanous species with a glabrous or slightly fibrillose stem.

(i.) Firmiores. Cap generally over 4 cm. broad, obtuse with incurved edge. Spores rarely ($<9\mu$).

(ii.) Tenuiores. Cap small (rarely over 4 cm. broad), often acute, straight-edged. Spores small ($<9\mu$).

Kauffman (1918) raises the subsection Scauri to the rank of a sub-genus, viz. *Bulbopodium,* and some authors have accepted this as a seventh sub-genus. The boundaries between these sub-genera are not always sharply defined and it becomes almost arbitrary at times into which of two such sub-genera one will place a species; hence their use is rather limited and of doubtful value, on an absolute basis, but for the sake of uniformity they have been included here. *Phlegmacium* and *Myxacium* include those species with viscid pileus, *Inoloma* and *Dermocybe* those with innately silky to scaly pileus and *Telamonia* and *Hydrocybe* those with a hygrophanous pileus.

Since several Cortinars have been found to yield extracts with antibiotic properties, it is important to open up the question of the taxonomic status of the Australian representatives. It is beyond the scope of this paper to attempt a complete revision except insofar as it is pertinent to the few species described here or to correct previously published inaccuracies.

It seems that those species listed by Cleland (1928 and 1935) as representatives of the sub-genus *Telamonia,* viz. *C. striatulus* Clel., *C. russeo-cinnamoneus* Clel., and *C. vinaceo-cinereus* Clel. would be more correctly considered under the sub-genus *Hydrocybe* while *C. fibrillosus* Clel. is probably a slender *Dermocybe.*

An additional record for this state is *C. austro-evernius* Clel. et Cheel as described by Cleland and Cheel (1918) from New South Wales, and this, too, appears to be a *Hydrocybe,* subsection Tenuiores.

The sub-genus *Dermocybe* is represented by a large number of species, the bulk of which are unnamed and undescribed. A wide variety of forms are found which grade closely from one to another, so that a whole range is met with which is very difficult to subdivide into species except in a few well-marked examples. Two closely related and well-marked species representative of this sub-genus are described below. Both are believed to be hitherto undescribed and so have been named *C. basirubescens* sp. nov. and *C. umbonatus* sp. nov. Both are characterized by tanny-brown, silky-fibrillose pilei, lighter ochraceous gills and strikingly pink tufts of mycelium at the base of the stem. The former is rare and is known only from a single locality from which specimens were found to be antibiotic, but the latter is more common in sclerophyll forest communities and has never shown activity from a large number of collections.

CORTINARIUS (DERMOCYBE) BASIRUBESCENS sp. nov.

Pileus small, 2 cm. to 4·5 cm. ($\frac{3}{4}$–$1\frac{3}{4}$ in.) in diameter, convex, smooth, silky, dry, Cameo Brown (xxviii) to Liver Brown (xiv) with darker patches near the centre to Blackish Brown (xlv). Flesh moderately thick beneath the centre, attenuated rapidly towards the periphery, but without pronounced umbo, creamy. Gills adnate with a slight sinus, moderately crowded, in four tiers, Mikado Brown (xxix) to Ochraceous Tawny (xv). Stem relatively stout, creamy near Chamois (xxx), with remnants of the darker cortina forming an imperfect arachnoid ring, slightly swollen towards the base, 4–6 cm. ($1\frac{1}{2}$–$2\frac{1}{2}$ in.) long and up to 1·25 cm. ($\frac{1}{2}$ in.) at base which sharply tapers to a tuft of crimson mycelium with the red colour tending to extend as a flush to almost half-way up the stipe. Spores light brown, smooth, mostly sub-globose to elongate-ellipsoidal, inequilateral, smallish, 9–12μ long $\times$ 8μ wide. Smell absent. Subcaespitose in soil around the base of a Eucalypt stump. Mylor, June.

The crimson mycelium at the base of the stipe with the tendency for a red flush to extend along it marks the species as very characteristic. The stouter stem suggests a probable relation with *Inoloma.*

Pileus 2–4·5 cm., convexus, glaber, sericeus, siccus, "Cameo Brown" ad "Liver Brown," in centro "Blackish Brown." Caro in exteriorem partem attenuata. Lamellae subsinuato-adnatae, subconfertae, "Mikado Brown" ad "Ochraceous Tawny." Stipes subcrassus, cremeus, 4–6 $\times$ 1·25 cm., ad basem mycelio coccineo. Annulus imperfectus, arachnoideus. Sporae, 9–12 $\times$ 8 micra. Plantae subcaespitosae.

CORTINARIUS (DERMOCYBE) UMBONATUS sp. nov.

Plate iii, fig. 1.

Pileus 5–6 cm. (2–2½ in.) across, distinctly umbonate at first, but spreading to become almost plane, silky smooth, dry, an even tanny brown near Kaiser Brown (xiv) or Sanford Brown (ii) to Burnt Sienna (ii), finely striate. Flesh thick over disk, attenuated rapidly towards periphery. Gills in four tiers, sinuato-adnate, more or less irregular along the edges, lighter than the pileus, Ochraceous Tawny (xv) or Clay Colour (xxix). Stem central, smooth, pallid above, browner below with tints of pileus, more or less equal, 6–11 cm. long, 10–12 mm. in diameter, slightly swollen at the base, and occasionally with tufts of pinkish mycelium. Spores light yellow, subglobose, ovoid to ellipsoidal, inequilateral, exospore slightly rough, obliquely apiculate 6–10μ × 5–7·5μ. Solitary to caespitose in sclerophyll forest. May to July, National Park, Waterfall Gully, Stirling.

This is quite a common, handsome species with its dark tanny brown umbonate cap and pale stem. Extracts of sporophores have not given positive antibiotic reactions.

Pileus 5–6 cm., subumbonatus deinde subplanus, sericeus, glaber, siccus, tenuiter striatus, "Kaiser Brown" vel "Sandford Brown" ad "Burnt Sienna." Caro in centro crassa, in exteriorem partem attenuata. Lamellae sinuato-adnatae, "Ochraceus Tawny" vel "Clay Color." Stipes glaber, supra pallidus, infra subfulvus, 6–11 cm. × 10–12 mm. Sporae, 6–10 × 5·75 micra.

CORTINARIUS (DERMOCYBE) OLEAGINUS sp. nov.

Plate ii, fig. 4.

Pileus small to medium, 2–6 cm. (¾–2¼ in.), very convex at first becoming almost plane at maturity and then usually accompanied by radial splitting, colours variable showing a range from light greenish yellow through olive tints to almost greenish blue. The basal colour of the pileus is yellow near Cream Buff (xxx) or Honey Yellow (xxx) with applied fibrils of the *velum universale* of light blue to lilac rendering the pileus olivaceous near Ecru Olive (xxx), Dark Olive Buff (xl), Artemesia Green (xlvii), Deep Grayish Olive (xlvi) to Pale Russian Blue (xlii). Flesh thin, yellow. Gills in four series, adnate to sinuato-adnate or decurrent by a tooth, light brown shades near Cinnamon Buff (xxix), Antimony Yellow (xv) to almost Ochraceous Tawny (xv) in old age. Stem slender to medium stout, up to 10 cm. long, attenuated slightly in either direction from 4 mm. to 12 mm., light creamy yellow with faint cinereous tints to strongly

developed lilac tints of the *velum universale,* and beset with scanty brown fibrillose remnants of the cortina. Spores rotund, yellow-brown, 7 × 6μ. Solitary to subcaespitose. Waterfall Gully, Crafers, May, June.

This is quite a handsome species exhibiting an exceptionally wide range of variations in colour tones. It provides a striking example of a cortina in which the basal colour of the pileus is modified by the closely appressed *velum universale* of quite a different colour. *Cort. austro-evernius* Clel. et Cheel is another example of such a modification, and the resultant wide range in colours is due to different amounts of vestigial universal veil. It should therefore be stressed that these colours should be indicated in describing the species, as they are of great use in working a key to the species.

Pileus 2–6 cm., convexus, deinde subplanus, viridi-flavus ad viridi-caeruleum vel olivarium. Caro tenuis, flava. Lamellae adnatae ad sinuato-adnatas, "Cinnamon Buff," "Antimony Yellow" et "Ochraceous Tawny." Stipes tenuis ad subcrassum, ad 10 cm. × 4–12 mm., cremeo-flavus cum colore veli universalis lilacino. Sporae globosae, 7 × 6 micra.

CORTINARIUS (TELAMONIA) VERONA-BRUNNEUS sp. nov.

Plate i, fig. 1.

Pileus small to medium, 3·5–5·0 cm. (1½–2 in.), slightly convex to irregularly plane, slightly umbonate, smooth to subfibrillose, Mikado Brown to Verona Brown (xxix) with lighter radial striations. Flesh dingy-pallid, thin, hygrophanous. Gills slightly sinuate, moderately close set, near Ochraceous Tawny (xv), 5 mm. deep. Stem 4·0–4·5 cm. long, moderately stout (5–8 mm.), equal to slightly attenuated below, and with a slight cavity terminating in a slightly bulbous base, pale above, tinted with Verona Brown (xxix) below where it is partially peronate by remnants of the universal veil. Spores yellow brown, oblique, 9 × 5μ. Solitary. Waterfall Gully; May.

This species is typical of *Telamonia* section Carnosi with relatively larger stem and spores than is found in the section Submembranacei. The sub-genus is not represented by many species in Australia, and those previously described by Cleland (1928–1934) for *Telamonia* are better considered as *Inolomas.*

Pileus 3·5–5 cm., subconvexus ad planum, irregulariter, subumbonatus, glaber ad subfibrillosum, "Mikado Brown" ad "Verona Brown." Caro subfusco-pallida, tenuis, hygrophana. Lamellae subsinuatae, subconfertae, "Ochraceous Tawny." Stipes 4–4·5 cm. × 5–8 mm., ad basem subbulbosus, supra pallidus, infra "Verona Brown" et subperonatus. Sporae, 9 × 5 micra.

CORTINARIUS (HYDROCYBE) CINNAMONEO-BADIUS sp. nov.

Plate ii, fig. 2.

Small plants. Pileus 1·5–2 cm., convex, subgibbous, expanding until almost plane with convex edge, hygrophanous, Verona Brown to Warm Sepia (xxix) or darker if moist, passing through Mikado Brown to Cinnamon to Orange Cinnamon (xxix), at first mealy with remnants of the veil, finally rather rugose with lacerated edge of cortina. Gills sinuate, moderately close, near Mikado Brown (xxix). Stem slender, 2–2·5 cm., whitish and clothed with whitish fibrillose remnants of the universal veil, flesh brownish with slight cavity. Spores subglobose to ellipsoidal, 9 to 12 × 6 to 9μ. Gregarious. Stonyfell, near Adelaide; July.

Pileus 1·5–2 cm., convexus, subgibbosus, deinde subplanus, hygrophanus, "Verona-Brown," "Warm Sepia," deinde exsiccatus "Mikado Brown" vel cinnamoneus. Lamellae sinuatae, subconfertae, "Mikado Brown." Stipes tenuis, 2–2·5 cm., albidus. Velum albidum. Sporae subglobosae vel ellipsoideae, 9–12 × 6–9 micra.

CORTINARIUS (HYDROCYBE) AUSTRO-EVERNIUS Clel. et. Cheel.

Plate i, fig. 2.

Plants small, slender. Pileus 3–3·5 cm. diameter, at first hemispherical becoming plano-convex, frequently slightly umbonate, becoming centrally depressed at maturity, moist to viscid under damp conditions, subfibrillose, near Deep Quaker Drab (li) to Pale Mouse Gray (li) with yellowish tints. The basal colour of the pileus is yellow, upon which is superimposed the blue tones of the *velum universale,* giving a range of shades from pale yellows through drab grays to light blues. Gills sinuate to adnate, generally close, 5 mm. deep, near Cinnamon Buff (xxxix). Stem 5–7 cm. long, rather flexuous, attenuated downwards but rather bulbous below, with tints of the cap becoming yellowish below, solid. Flesh pallid white becoming yellowish. Spores rotund, 7·5, 5·6–7·5μ, yellow-brown. Subcaespitose. Waterfall Gully; May.

CORTINARIUS (PHLEGMACIUM) IANTHINUS sp. nov.

Plate iii, fig. 3.

Plants medium to large. Pileus up to 9 cm. (3½ in.) in diameter, at first hemispherical becoming almost plane, rather irregular, smooth, moist, pallid to lavender or violet near Plumbago Blue (xliii) to Pale Aniline Lilac or Aniline Lilac (xxxv) or Bluish Lavender (xxxvi), striate with the remnants of the universal veil which is russet near Morocco Red (ii) and may give the pileus reddish-purplish tonings near Russet Vinaceous (xxxix) or Vinaceous Brown

(xxxix). Flesh thick, white, sometimes exposed by radial cracks. Gills close set to coarse, multiseriate, sinuato-adnate or decurrent by a tooth, at first with faint lilac tints, becoming cinnamon to browner with age near Light Ochraceous Salmon (xv), Cinnamon (xxix) to Mikado Brown or Tawny (xv). Stem stout and long, to 11 cm. × 20 mm., slightly broader at the base, violet concolourous with the basal colour of the pileus, fibrillose with remnants of the universal veil, near Mahogany Red (ii). Spores yellow brown, obliquely apiculate, 11–13 × 8μ. Solitary to subcaespitose. Morialta, Myponga, Waterfall Gully; May, June, July.

Pileus ad 9 cm., primum hemisphericus deinde planus, glaber, humidus, ianthinus. Caro crassa, albida. Lamellae sinuato-adnatae, primum sublilacinae, deinde cinnamoneae ad fuscas. Stipes crassus, 11 cm. × 2 cm., ianthinus. Velum universale "Morocco Red" vel "Mahogany Red." Sporae 11–13 × 8 micra.

CORTINARIUS (PHLEGMACIUM) VIOLACEO-HINNULEUS sp. nov.

Plate ii, fig. 3.

Pileus 5–6 cm. (1½–2½ in.), convex becoming plane to upturned, often more or less gibbous, margin wavy with a tendency to radial splitting, surface sticky when moist, more or less matt, chamois-coloured near Avellaneous (xl) to as dark as Saccardo's Umber (xxix) near umbo, but mostly Snuff Brown (xxix), faintly striate. Gills multiseriate, sinuato-adnate to decurrent by a tooth, usually close set, 4 mm. deep, light brown near Clay Colour (xxix) or Buckthorn Brown (xv). Stem slender, 5–7 cm. long (2–3 in.) and 5–6 mm. but occasionally up to 10 mm. thick, slightly broader at the base, white with pronounced lavender to lilac tints near Endive Blue (xliii) or Dark Dull Bluish Violet (xxiv) to Antimony Yellow (xv). Spores obliquely ellipsoid, 9μ × 5·2–6·2μ. In stringybark forest, Waterfall Gully; May.

The species name is derived from the violet stem and the chamois or fawn coloured pileus (hinnuleus L. fawn).

Pileus 5–6 cm, convexus, deinde planus ad concavum, subgibbosus, viscidus, "Avellaneous," "Saccardo's Umber," vel "Snuff Brown." Lamellae sinuato-adnatae vel subdecurrentes, "Clay Colour" vel "Buckthorn Brown." Stipes subtenuis, 5–7 cm. × 5–6–10 mm., pallidus cum coloribus violaceis. Sporae ellipsoideae, 9 × 5·2–6·2 micra.

CORTINARIUS (PHLEGMACIUM) BASIBULBOSUS sp. nov.

Plate i, fig. 2.

Plants medium to large. Pileus 4·5 to 11 cm. (1¾–4¼ in.), irregularly convex becoming more or less plane, smooth, somewhat sticky when moist, shining when dry to subfibrillose, near Tawny (xv). Flesh pallid tinted to tawny, somewhat semi-translucent in parts. Gills sinuate, somewhat ventricose, moderately close near Ochraceous Tawny (xv), to 1 cm. deep. Stem stout, 2·5 to 5 cm. long,

15 to 25 mm. broad with distinct marginate bulb 2–4 cm. at widest, silky fibrillose to striate with cortinal remnants, pallid with tawny tints, solid. Spores 7·5μ ×5μ, yellow brown, ellipsoidal, rather small, 7·5 × 5μ. In Eucalypt forest, Crafers, May.

Both this species and the next are representatives of the section Scauri of sub-genus *Phlegmacium*. Some authors (e.g. Kauffman, 1918) have raised this section to sub-generic rank under the name of *Bulbopodium*, but we prefer to follow Lange (1938) and merge them with other closely related species under *Phlegmacium*.

Pileus 4·5–11 cm., convexus irregulariter, deinde planus, glaber, subviscidus, exsiccatus nitidus ad subfibrillosum. Caro pallida. Lamellae sinuatae, subventricosae, subconfertae, ochraceo-fulvae. Stipes crassus, 2·5–5 cm. × 15–25 mm., marginato bulbo (2–4 cm.), sericeo-fibrillosus vel striatus, pallidus cum colore fulvo. Sporae 7·5 × 5 micra.

CORTINARIUS (PHLEGMACIUM) LAVENDOCAERULEUS *sp. nov.*

Plate ii, fig. 1.

Medium sized plants. Pileus 4–5 cm. (1½–2 in.), at first almost hemispherical, later convex and more irregular, surface dull, viscid when moist, with basal brown colour of pileus tending to be modified by the closely appressed whitish and slightly lavender tinted universal veil, Iron Gray (li) to Drab or Hair Brown (xlvi). Flesh bluish white. Gills narrow, close set, adnate, Grayish Olive (xlvi) with bluish tints becoming browner with age. Stem stout, 4 cm. × 18 mm. broad, bulbous below to 25 mm., Pale Forget-me-not Blue (xxi), fibrillose with remnants of cortina and universal veil. Spores obliquely ellipsoidal, yellow brown in mass, 9–11 sometimes 12·5 × 6·7μ. Densely caespitose. Aldgate; April.

This is also a representative of the section Scauri of sub-genus *Phlegmacium*.

Pileus 4–5 cm., primum subhemisphericus, deinde convexus et irregularis, non-nitidus, viscidus, "Iron Gray," "Drab" vel "Hair Brown." Velum universale sublavendulense. Caro lavendulense pallida. Lamellae adnatae, augustae, confertae, "Grayish Olive" cum coloribus lavendulensibus. Stipes crassus, 4 cm. × 18 mm., ad basem bulbosus, fibrillosus, "Pale Forget-me-not Blue." Sporae 9–11–12·5 × 6–7 micra. Plantae caespitosae.

NOTES ON MEMBERS OF THE GENUS *CORTINARIUS*.

Cortinarius rotundisporus Clel. et Cheel. A coloured illustration of this fungus appears in Cleland and Cheel (1918) as does also *Cort. austro-evernius* Clel. et Cheel and typical material of the two may be readily compared and contrasted in this plate. *Cort. rotundisporus* Clel. et Cheel is a shorter, stouter

plant in which the blue colours are well developed, but *Cort. austro-evernius* is taller and more slender with basal colours of yellow to buff overlaid with blue tints from closely appressed remnants of the *velum universale.* Both have been found to possess antibiotic properties, but while the former has been tested from only a few collections, the latter has been found in relatively larger amounts, and it is this plant which has been studied by Atkinson (1946) and erroneously identified as *Cort. rotundisporus* Clel. et Cheel. Plate i, fig. 3 (S.A. Mus. Water-colour, No. 92) illustrates plants under drier growing conditions when the blue tints are not so well developed and is thus somewhat atypical.

Cortinarius albidus Clel. This representative of *Myxacium* has been described by Cleland (1933,1934) under the name above, but it has been found to be untenable since the same specific name has been used for a Friesian species, *vide* Lange (1938). Therefore, we propose that the Australian material be referred under the new name *Cortinarius austro-albidus nom. nov.*

Cortinarius sanguineus (Wolf.) Fr. Within the sub-genus *Dermocybe* there are recognized in Europe three closely related bright red species, viz., *Cort. sanguineus* (Wolf.) Fr., *Cort. cinnabarinus* Fr. and *Cort. anthracinus* Fr., of which only the first named is recorded from South Australia by Cleland (1934) and the first two from Victoria by Willis (1941). There seems to be a whole range of these scarlet species, and as a first step towards the clarification of the position of valid species, we have included a coloured illustration of typical material of *Cort. sanguineus* (Wolf.) Fr. in plate iii, fig. 4 (S.A. Mus. Water-colour, No. 97).

SUMMARY.

An investigation has been made upon the taxonomy of higher fungi exhibiting antibiotic properties from South Australian collections. A new variety of *Agaricus* L. ex Fr. and nine new species of *Cortinarius* (Pers. ex Fr.) S. F. Gray have been described as well as one new name and notes on four other Cortinars. Antibiotic activity has been recorded for extracts of sporophores of *Agaricus xanthodermus* var. *antibioticus* var. nov., *Cortinarius austro-evernius* Clel. et Cheel, *C. rotundisporus* Clel. et Cheel, *C. oleaginus* sp. nov. and *C. basirubescens* sp. nov. A rearrangement of certain species of Cortinars into their respective sub-genera has been made, especially with respect to sub-genera *Telamonia* and *Hydrocybe.*

ACKNOWLEDGEMENT.

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BIBLIOGRAPHY.

Ainsworth, G.C. and Bisby, G. R. (1943) : A Dictionary of the Fungi. *Imperial Mycological Institute,* Kew.

Atkinson, Nancy (1946) : Antibacterial Activity in Members of the Higher Fungi. 1. *Cortinarius rotundisporus* and *Psalliota xanthoderma* Genev. *Aust. Jour. Exp. Biol. and Med. Sci.,* xxiv (3), pp. 169–173.

British Mycological Society (1940) : *Trans.,* xxiv, pp. 283–292.

Cleland, J. B. and Cheel, E. (1918) : Australian Fungi : Notes and Descriptions, No. 1. *Trans. Roy. Soc. S. Aust.,* xlii, pp. 88–138, pl. ix–xii.

Cleland, J. B. (1928) : Australian Fungi : Notes and Descriptions, No. 7. *Trans. Roy. Soc., S. Aust.,* lii, pp. 217–222.

Cleland, J. B. (1933) : Australian Fungi : Notes and Descriptions, No. 9. *Trans. Roy. Soc., S. Aust.,* lvii, pp. 187–194.

Cleland, J. B. (1934) : Toadstools and Mushrooms and other larger Fungi of South Australia, Part I. *British Science Guild Handbook,* Adelaide.

Cooke, M. C. (1892) : Handbook of Australian Fungi. London.

Kauffman, C. H. (1918) : The Agaricaceae of Michigan. Michigan.

Lange, J. E. (1938) : Flora Agaracina Danica, III. Danish Society for Advancement of Mycology, Copenhagen.

Mathieson, J. (1946) : Antibiotics from Victorian Basidiomycetes. *Aust. Jour. Exp. Biol. and Med. Sci.,* xxiv (1), pp. 57–62.

Ramsbottom, J. (1945) : Poisonous Fungi. Penguin Books, London.

Rea, Carlton (1922) : British Basidiomycetae. Cambridge University Press.

Wilkins, W. H. and Harris, G. M. C. (1944) : Investigations into the production of bacteriostatic substances by Fungi. VI. Examination of the larger Basidiomycetes. *Annals of Applied Biol.,* xxxiv (4), pp. 261–270.

Wilkins, W. H. (1947) : Investigations into the production of bacteriostatic substances by Fungi. Preliminary examination of the sixth 100 species, more basidiomycetes of the wood-destroying type. *Brit. Jour. Expl. Path.,* xxviii, No. 1, pp. 53–56.

Willis, J. H. (1941) : Victorian Fungi. *Field Naturalists Club of Victoria,* Melbourne.

EXPLANATION OF PLATES.

Plate i.

Fig.1. *Cortinarius* (*Telamonia*) *verona-brunneus* sp. nov.
Fig. 2. *Cortinarius* (*Phlegmacium*) *basibulbosus* sp. nov.
Fig. 3. *Cortinarius* (*Phlegmacium*) *rotundisporus* Clel. et Cheel.
Fig. 4. *Agaricus xanthodermus* var. *antibioticus* var. nov.

Plate ii.

Fig. 1. *Cortinarius* (*Phlegmacium*) *lavendocaeruleus* sp. nov.
Fig. 2. *Cortinarius* (*Hydrocybe*) *austro-evernius* Clel. et Cheel.
Fig. 3. *Cortinarius* (*Phlegmacium*) *violacco-hinnuleus* sp. nov.
Fig. 4. *Cortinarius* (*Dermocybe*) *oleaginus* sp. nov.

Plate iii.

Fig. 1. *Cortinarius* (*Dermocybe*) *umbonatus* sp. nov.
Fig. 2. *Cortinarius* (*Hydrocybe*) *cinnamonco-badius* sp. nov.
Fig. 3. *Cortinarius* (*Phlegmacium*) *ianthinus* sp. nov.
Fig. 4. *Cortinarius* (*Dermocybe*) *sanguineus* (Wolf.) Fr.

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A REVISION OF THE LACERTILIAN GENUS *TYMPANOCRYPTIS*

By FRANCIS J. MITCHELL, South Australian Museum.

Plates iv–vi and text fig. 1–10.

INTRODUCTION.

An initial attempt has been made to deal as comprehensively as present knowledge and collections will allow with the agamoid genus, *Tympanocryptis*, the species of which have been the subject of considerable controversy. The author's original intention in examining as many specimens and attendant data as possible was to determine the status and variation of the disputed forms. Collections at present available, however, have proved insufficient, and, as is often the case in preliminary papers of this nature, material from many key localities is lacking. In consequence, no conclusive decisions have been reached on several problems.

This preliminary examination showed that additional taxonomic work was still necessary, for owing to the non-comprehensive approach and few specimens of previous authors, confusion had resulted over the identification and distribution of the Central Australian species. Consequently, all available data have been gathered in a survey of the genus, and as a result five species and three races including five new forms are here recognized.

These new forms are as follows:

Tympanocryptis intima sp. nov.

This species, which has previously been mistaken for *T. cephalus* Gunther, inhabits the Eyrean Basin.

Tympanocryptis maculosa sp. nov.

This species, unique in the genus, because of the presence of femoral pores extending along the thigh, inhabits the barren salty surface of Lake Eyre North. Twenty specimens were taken by the late Dr. C. T. Madigan during his 1929 expedition to the Lake.

Tympanocryptis uniformis sp. nov.

This unusual form has been erected tentatively as a species, its relatively uniform scalation contrasting sharply with the rugose scaling of the other species. Founded on a single specimen taken near Darwin, Northern Territory.

TYMPANOCRYPTIS LINEATA PINGUICOLLA subsp. nov.

A stout, short-limbed race inhabiting parts of Southern Victoria.

TYMPANOCRYPTIS CEPHALUS GIGAS subsp. nov.

This race appears to inhabit the upland area bounded by the Gascoyne and Fortescue Rivers, Western Australia.

After an examination of all four-pored specimens available, it has been decided to reinstate *tetraporophora* Lucas and Frost, as a race of *T. lineata* Peters,

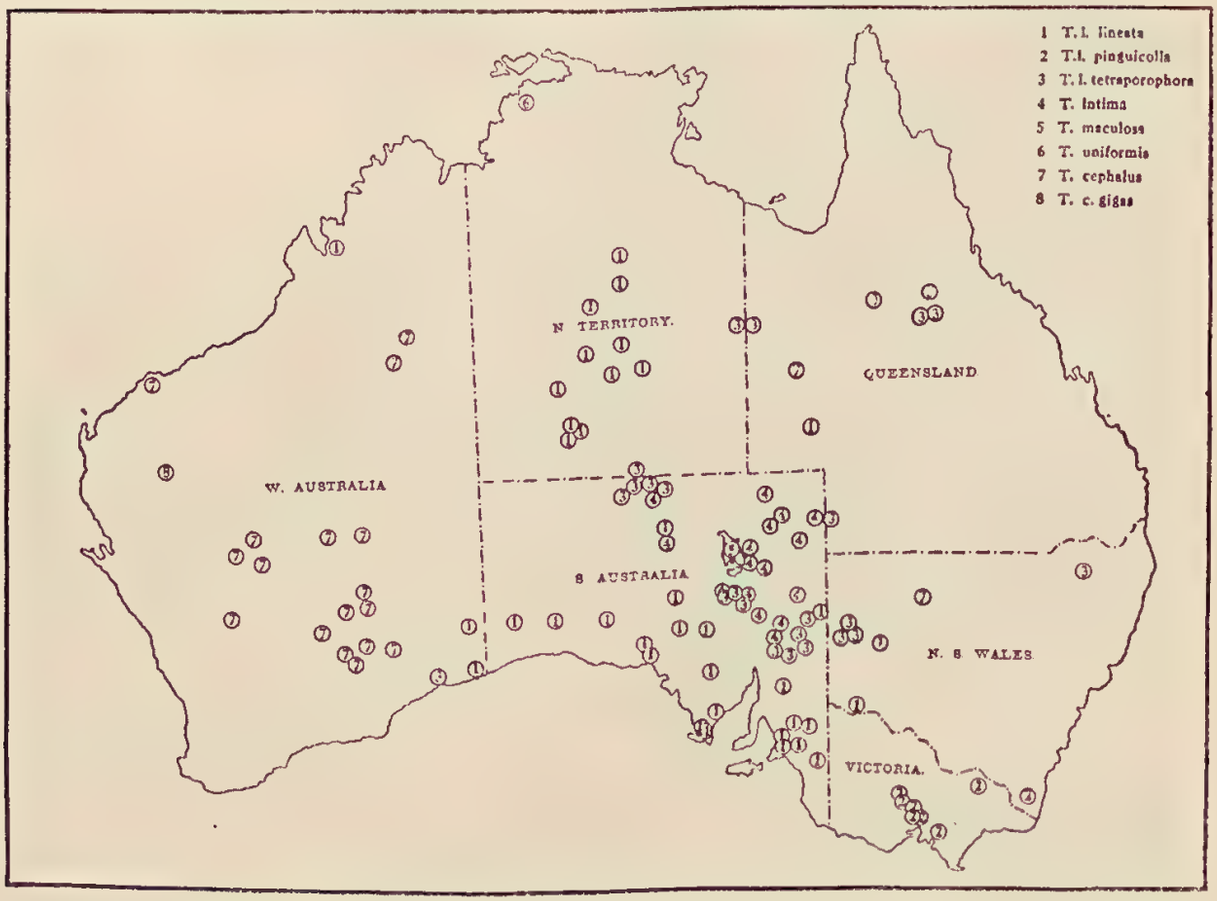

Fig. 1. Distribution map, showing the approximate localities at which recorded specimens have been taken.

although its status and position still remain doubtful. The description of *T. cephalus* Gunther has been amplified. Consideration of Sternfeld's reasons for the recognition of the race *centralis* has resulted in its being placed in the synonomy of *T. lineata lineata* Peters.

Many of the descriptive characters previously in use are common to more than one race and several generally neglected and seemingly trivial, but constant characters have been utilized herein in separating the various forms. The chief of

these minor features are the shapes of the dorsal tubercles, and the number of scales separating the nasal from the upper labials. In view of these additions to diagnoses, detailed redescriptions of the previously known species have been given for comparative purposes.

All relevant literature known to the author has been noted, and papers not otherwise referred to and present in the bibliography contain locality data.

Although all available material has been examined, extensive field work must be undertaken before an accurate conception of the status and evolution of the species in this unusually distributed genus can be formed. With the exception of the species in and around the Eyrean Basin, the extreme distribution lines cannot be plotted to an extent sufficient to determine the presence or absence of overlap, and consequently the author has been unable to verify the status of several forms.

It will be noted that in the locality and registration lists, South Australian Museum registration numbers refer to the locality of a collection, and not to any individual specimen, unless it be the only specimen in the collection. Where necessary, specimens are designated a, b, c, etc., under the collection registration number. In the above-mentioned lists the following abbreviations of Museum titles have been utilized: "B.M.," British Museum, London; "A.M.," Australian Museum, Sydney; "S.A.M.," South Australian Museum, Adelaide; "N.M.," National Museum, Melbourne; "W.A.M.," Western Australian Museum, Perth; and "M.M.," Macleay Museum, Sydney.

The head length as given is the distance from the tip of the snout to the gular fold, and the body length, the distance from the gular fold to the anus.

TYMPANOCRYPTIS Peters.

Tympanocryptis Peters, 1863, p. 320; Boulenger, 1885, p. 392; Lucas and Frost, 1896, p. 131.

In view of the discovery of a species possessing four to seven femoral pores, the generic redescription of Lucas and Frost (1896) must be further modified.

A modified generic description is as follows: Tympanum covered with scales, its position usually marked with a depression; body depressed, covered dorsally with heterogeneous scales; upper head scales small, asymmetrical; ventral scales uniform. A strong gular fold, but no gular sac; angle of the mouth and axilla-groin skin folds present or absent. Tail round or slightly depressed at the base. Femoral and/or preanal pores present, usually in both sexes[1].

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1 Critical microscopic examination is often required to find the pores in some female specimens.

KEY TO THE SPECIES AND SUBSPECIES OF *TYMPANOCRYPTIS*.

1. Femoral pores present 3
2. Femoral pores absent 5
3. Preanal pores present 15
4. Preanal pores absent .. .. *maculosa*
5. Dorsal scales smooth 7
6. Dorsal scales keeled 11
7. Enlarged tubercles sparse, wider than long and tending to form four longitudinal series .. .. *intima*
8. Enlarged tubercles and spines tending conical 9
9. Head short, deep, about as wide as long .. .. *cephalus cephalus*
10. Head large, flat, wider than long .. .. *cephalus gigas*
11. Enlarged scales flat with a simple central keel .. .. .. *uniformis*
12. Enlarged scales raised and spinously tubercular 13
13. Enlarged tubercles with basal length longer than height .. *lineata lineata*
14. Enlarged tubercles with basal length shorter than height *lineata pinguicolla*
15. Two preanal and two femoral pores present .. *lineata tetraporophora*

TYMPANOCRYPTIS INTIMA sp. nov.

Tympanocryptis cephalus (*non* Gunther) Lucas and Frost, 1896, p. 131; Zietz, 1917, p. 470; Kinghorn, 1945, p. 5.

Form stout; head longer than broad, covered with flat, smooth or slightly rugose scales, 11–14 occurring between the supraciliary ridges. Nostril oval, pierced in an enlarged nasal, which is separated from sixteen upper labials by five rows of scales. Nostril directed forward and downward, situated about midway between the eye and the tip of the snout. Body strongly depressed, covered dorsally and laterally with small, non-keeled, and not or but slightly imbricate scales; intermixed sparsely with enlarged spinous tubercles which tend to be disposed in four longitudinal series. These enlarged tubercles are wider than long with rounded anterior edges as figured. Limbs and tail short, the adpressed hind limb reaching to the shoulder; covered with feebly keeled scales intermixed on the thighs with enlarged mucronate tubercles. Ventral and gular scales smooth. Eighteen and ten spinous bicarinate lamellae under the fourth and third toes respectively. Preanal pores present, 1+1.

Colouration of the type. Ground colour light grey-brown with eight darker brown indefinite blotches, four on either side of the vertebral line. Dorso-lateral lines absent. Twelve darker caudal cross-bands and a grey nape band are present. Ventral surfaces white.

General colouration. The ground colour varies from dull grey to brick red dependent on the locality; the quadrate spots are seldom present and if so merely

as indefinite blotches. There is no caudal banding in some specimens; ventral surfaces white or occasionally finely spotted with brown in the gular and chest regions of male specimens.

Measurements. Holotype female, S.A.M., R2331.

Total length : 123 mm.
Body length : 41 mm.
Tail length : 66 mm.
Head length : 16 mm.
Head width : 13 mm.
Fore limb : 25 mm.
Hind limb : 38 mm.

Distribution. This species inhabits the open gibber deserts and spinifex flats of the Eyrean Basin, to which area it is principally restricted occurring

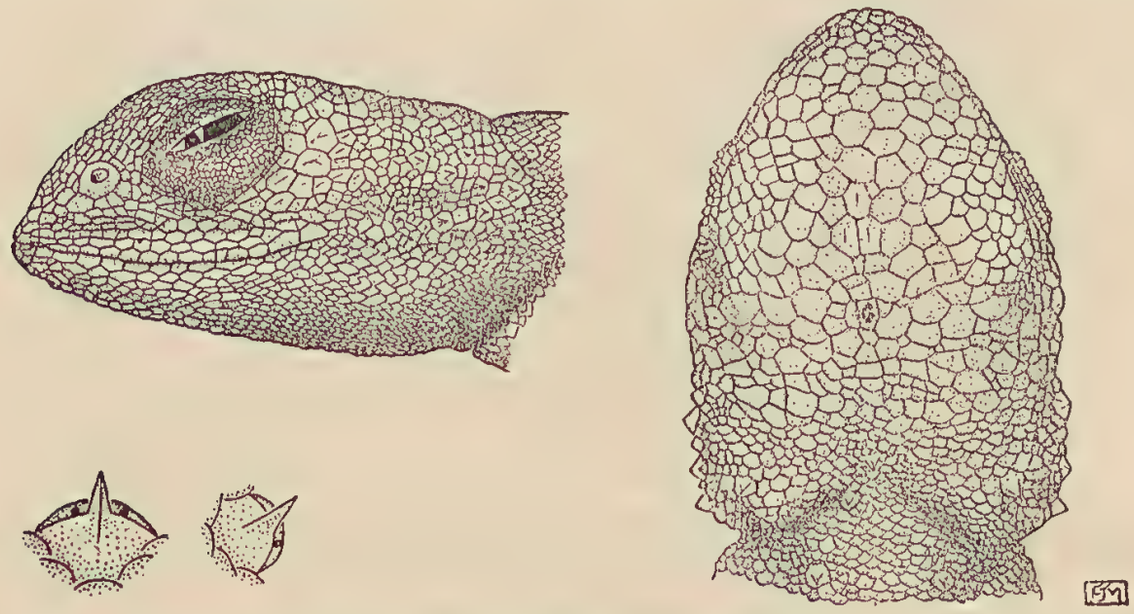


Fig. 2. *Tympanocryptis intima*: dorsal and lateral views of the head (×3) and an enlarged spinous tubercle (×5) of the holotype female.

right to the edge of Lake Eyre. It also appears to have encroached beyond this into the distributions of *lineata* and *lineata tetraporophora* along the southern, western and eastern extremities of its distribution.

Loc. South Australia: Oodnadatta (S.A.M. R2331, type); 20 miles north of Macumba Creek (S.A.M. R2444, part); Mt. Hopeless (S.A.M. R746); Marree (S.A.M. R2432, R2449); Innaminka (S.A.M. R744); Killalpaninna (S.A.M. R743); Clayton (S.A.M. R745); Strzelecki Creek (S.A.M. R747); Leigh Creek (S.A.M. R2452); Lake Callabonna (S.A.M. R988); Finniss Springs (S.A.M. R2525, part); 4 miles south-west of Marree (S.A.M. R2597, part); Camp 49, Simpson Desert Expedition (A.M. R673); Central Australia (N.M.

R1164–R1178); South Australian Museum Expedition to Lake Eyre District (S.A.M. R748).

Also Camp 31, Goyder Lagoon, according to Kinghorn (1945).

This species, which often has been mistaken for *cephalus*, owing to the insufficient description of the last-named, can be distinguished easily from it by the sparse and singly distributed dorsal tubercles. The variation that occurs in this species is of little significance, the principal variant being the number and disposition of the tubercles. These are relatively few and tend to be disposed in four longitudinal series. In some specimens the aligning is almost perfect, while in others the tubercles are irregularly scattered over the dorsal surface. The tubercles of specimens taken near the edge of Lake Eyre are more flattened and non-spinous, although still retaining their seried disposition.

Although distinct and easily distinguishable this species does not at first appear worthy of full specific status, and was thought only a race. However, careful examination of collections and the compilation of distribution maps has led to the finding of definite and substantial overlap on the western, southern and eastern extremities of its distribution. Typical specimens of *intima* have been taken at several localities within the recorded ranges of *lineata* and *lineata tetraporophora*, and in one collection (S.A.M. R2597) typical *intima* and *lineata tetraporophora* are labelled as having been taken under the same stone. Similarly there is a single specimen of *intima* in a collection of *lineata tetraporophora* from "20 miles north of Macumba Creek, South Australia" (S.A.M.), and several other instances could be tabulated.

This evidence leaves little doubt that *intima* is biologically separate from the surrounding populations, and must therefore be granted full specific status.

TYMPANOCRYPTIS CEPHALUS Gunther.

Tympanocryptis cephalus Gunther, 1867, p. 52; Boulenger, 1885, p. 393, pl. xxxi, fig. 1; Stirling and Zietz, 1893, p. 168.

Tympanocryptis lineata cephalus Kinghorn, 1932, p. 360.

Form stout; head, deep with obtuse snout, slightly longer than broad. Tympanum depression indistinct in both sexes. Nostril oval, directed forward and downward; nasal enlarged and resting on an ill-defined canthus rostralis; separated from fifteen to seventeen upper labials by five to seven rows of scales. Upper head scales raised and rugose but not keeled, there being 13–16 between the supraciliary ridges and 6–9 separating the nasals. Body strongly depressed, covered with smooth heterogeneous scales; intermixed irregularly with raised, often tending conical tubercles which have a small keeled spine at the summit.

These tubercles occur in clumps of two, three or more adjacent, and are not singly distributed as in the other species. Ventral scales uniform and smooth. Tail and limbs short, the adpressed hind limb reaching to the shoulder in females and between it and the tympanum depression in males; tail strongly depressed at the base. A strong transverse gular fold present; angle of the mouth fold feebly present or absent; axilla-groin fold absent. Sixteen to eighteen and twelve spinous bicarinate lamellae under the fourth and third toes respectively. Preanal pores present, 1+1.

Colouration. Ground colour grey-brown to red-brown dorsally, lightening dorso-laterally to creamy-white ventrally. Tail with eight to ten very strong

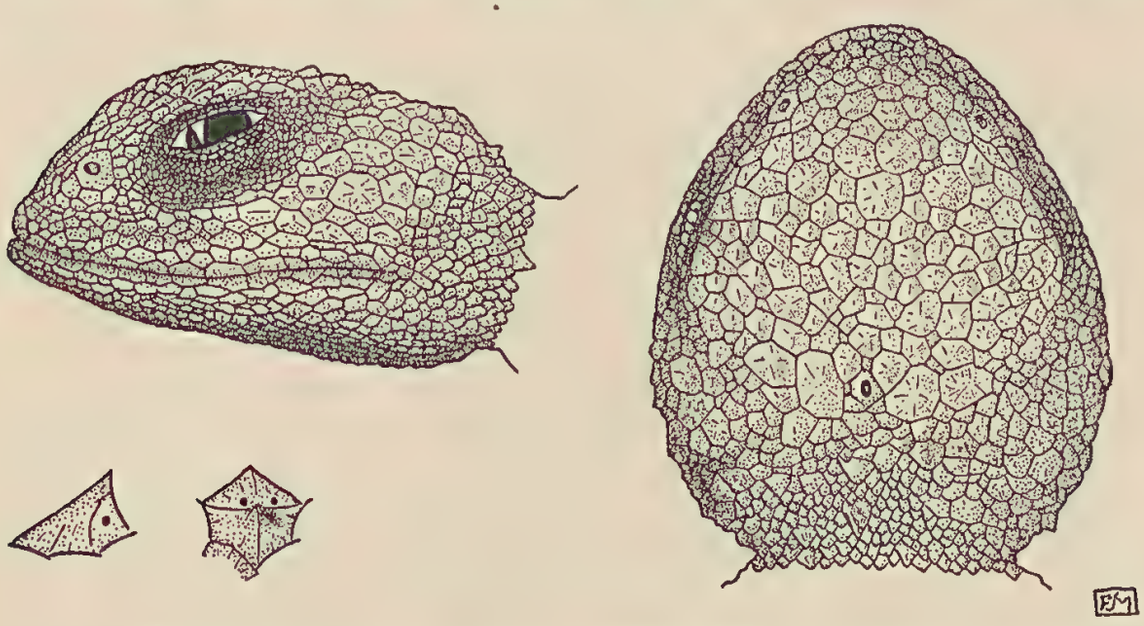


Fig. 3. *Tympanocryptis cephalus cephalus*: dorsal and lateral views of the head (×3) and an enlarged dorsal tubercle (×5) of a typical male specimen—W.A.M. R7067.

black cross-bands which generally extend right around the tail and not just dorsally as with the other species. The first curved tail band is very prominent. A dark brown nape band is present in many specimens. There are no quadrate spots or bands on the body. The ventral surfaces of some male specimens are faintly spotted with brown.

Measurements. W.A.M., R6755, female.

Total length: 116 mm.	Head width: 15 mm.
Body length: 38 mm.	Fore limb: 26 mm.
Tail length: 60 mm.	Hind limb: 35 mm.
Head length: 18 mm.	

Distribution. This species has been taken over the greater part of the Western Australian Shield. Kinghorn (1932) described a specimen from

Ardmore, in north-western Queensland. This specimen (A.M. R10307) has been examined and found to be recognizable although not typical *cephalus*. Similarly a specimen from Tilpa, New South Wales (A.M. R11082) also has definite affinities with *cephalus*. Both of these specimens have 5–7 scales separating the nasal from the upper labials, and typical *cephalus* colouration. The tubercles, however, are less rugose with a central keel terminating in a small spine. In the Ardmore specimen these tubercles are raised and clumped as in typical *cephalus*, although for the most part singly distributed in the Tilpa specimen.

Loc. Western Australia: Nicol Bay (British Museum co-type); Murchison Goldfield (S.A.M. R2437); Murchison District (S.A.M. R2439, W.A.M. R2001); Broad Arrow (S.A.M. R2422); Laverton (W.A.M. R1757, R1499, R1242, R1758, R1360, R1305, A.M. R3370); Kurrawang (W.A.M. R6755, R6434, R6754, R6435); Meekathara (W.A.M. R2006); Kalgoorlie (W.A.M. R6543, R4329, R6542, R6544); Lake Wells District (W.A.M. R1606); Grant Patch (W.A.M. R7076); Bulong (W.A.M. R3748); Canning Stock Route (40–43), (W.A.M. R3990); Wiluna (W.A.M. R7302); Londonderry (W.A.M. R2346); Western Australia (A.M. R6243). Queensland: Ardmore (A.M. R10307–12). New South Wales: Tilpa (A.M. R11082).

The above description, although agreeing in essentials, differs in detail from Gunther's type description. Photographs and data kindly supplied by the British Museum support the accuracy of Gunther's short description (1867) and Boulenger's figure (1885), but demonstrate that the specimens in this, the only coastal collection so far made differ in scalation detail from inland specimens. It has been suggested by a fellow worker that this inland form should be described as a new race. However, after considering that no similar specimens have been taken, it is assumed that the type specimens are merely local variants, and not typical representatives of the species which Gunther in fact described.

In view of this, specimens agreeing with the above description are regarded tentatively as typical of the species. It is apparent from Boulenger's figure and the British Museum photograph of a co-type that these agree basically with inland specimens.

Another interesting factor, previously noticed by Kinghorn (1932) is the form and number of scales separating the nasals. The transverse head scale count generally used, and applied in this paper is that between the supraciliary ridges. It can be seen that these counts are approximately equal in all species. The rugose head shields of *cephalus* are undoubtedly larger than those of the other species relative to the head dimensions, the short snout and yet wide head of *cephalus* accounting for the similar transverse supraciliary counts. Dealing with a larger number of specimens, the count between the nostrils has not be found as consistent as Kinghorn apparently found it, although a definite division between the average

numbers is apparent. In an examination of all specimens available the following averages have been found: *cephalus,* 7·7, range 6–9; *lineata* 10·4, range 8–13.

Although the existence of this species has been verified by several authors its status has always remained doubtful. Present evidence lends little assistance in solving this problem, for although *cephalus* is now shown to possess sufficient structural differences for specific separation, its status cannot be verified owing to the absence of detailed collections from the *cephalus-lineata* border-line areas. Also it is difficult to see the relationship of the Ardmore and Tilpa specimens, as they appear to be separated from the main *cephalus* population by a *lineata* population inhabiting practically the whole of the Northern Territory. Possibly there is a general overlap throughout the whole of the little known northern section of the Northern Territory.

TYMPANOCRYPTIS CEPHALUS GIGAS subsp. nov.

Form moderate to stout; head strongly depressed, much longer than broad with rounded canthus rostralis. Nostril oval, directed forward and downward; pierced in the upper half of an enlarged nasal which rests almost on the rostralis, making the nostril just visible when the head is viewed dorsally; nearer the eye than the tip of the snout. Upper head scales smooth becoming slightly tuberculate in the temporal region; 10–12 present between the supraciliary ridges and 6–7 separating the nasals; 6–7 scales separate the nasal from fourteen upper labials. Eye-lids larger and more prominent than in typical *cephalus.* Body strongly depressed; covered with non- or slightly imbricate heterogeneous scales; intermixed dorsally with clumps of spinous tubercles of the type figured. Ventral scales smooth. A strong gular fold present; angle of the mouth and axilla-groin folds absent. Limbs moderate; covered with mucronulately keeled scales; when adpressed the hind limb reaches to the tympanum depression. Sixteen and twelve spinous bicarinate lamellae under the fourth and third toes respectively. Preanal pores present, 1+1.

Colouration. Ground colour creamy-yellow; body traversed by four indefinite rich brown bands. Tail with ten transverse bands the first of which is very prominent. There are no upper head markings present and all ventral surfaces are white. A nape band is faintly present.

Measurements. Holotype male, S.A.M. R2434.

Total length: 156+ mm.
Body length: 39 mm.
Tail length: 95+ mm.
Head length: 22 mm.
Head width: 16 mm.
Fore limb: 28 mm.
Hind limb: 44 mm.

Distribution. This race is at present known from only a single locality, the extent of which is unknown, three specimens having been taken (separately ?) "between Ashburton and Gascoyne Rivers, Western Australia." Further collecting in this area may reveal it to inhabit the whole of this 2,000–4,000 ft. area including the Hamersley Ranges.

Loc. Western Australia: "Between Ashburton and Gascoyne Rivers" (holotype and two paratypes, S.A.M. R2434).

This race is founded on comparatively little data, as only three specimens from a single locality have been examined. However, the consistency of the diverse characters, together with the fact that the type and only known locality

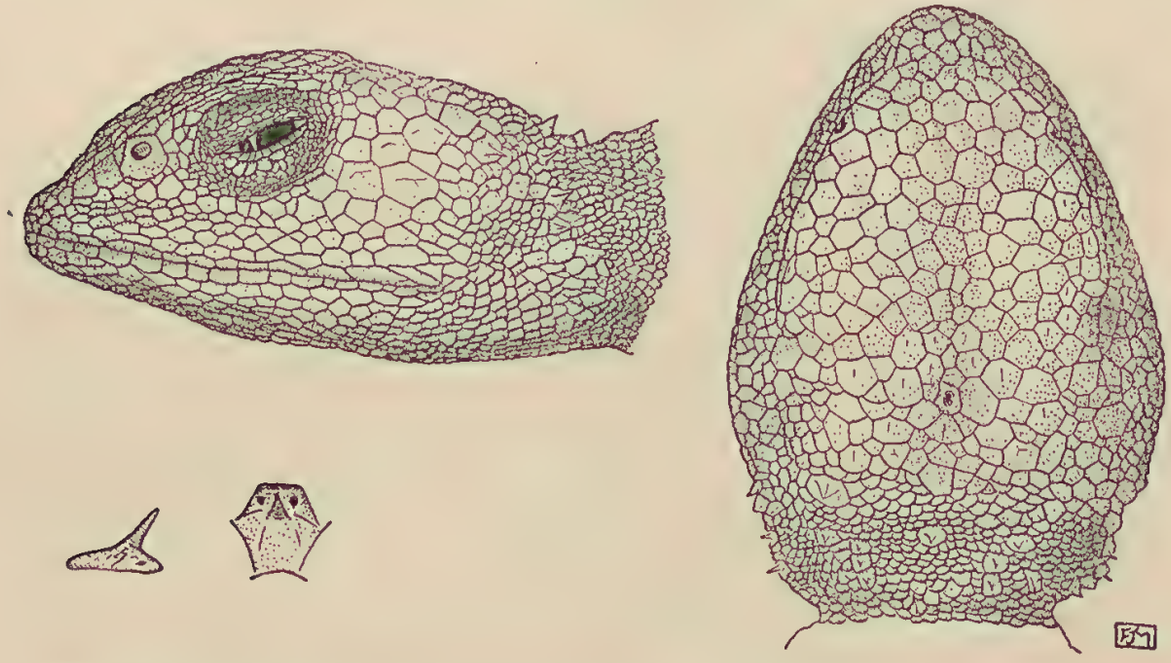


Fig. 4. *Tympanocryptis cephalus gigas*: dorsal and lateral views of the head (×3) and an enlarged dorsal tubercle (×5) of the holotype male.

is in the ecological upland niche of the Hamersley, Teano, Waldburg Range area, Western Australia (where many races, notably in Lepidoptera, have previously been found), have led to its tentative recognition as a subspecies. In a letter, Kinghorn, who kindly examined these specimens, suggested that they were merely fully adult specimens of typical *cephalus*. In an examination of all available specimens of the typical race, fully adult and pregnant females have been found to a maximum length of 122 mm. (A.M. R6243). The males are generally much smaller. The smallest of the three types measures 137 mm. and the largest 177 mm. The scalation differences and depression of the head and body are just as prominent in the smaller specimen as in the larger, and typical *cephalus* scalation is just as prominent in the 122 mm. female as in the smallest male.

Laterally, the conical spine which occurs dorsally, especially frontodorsally gives way to spines which are less prominent and directed forward, being in some cases slightly keeled and similar to those of *intima*. The tubercles, although in clumped formation, in no way exhibit the raised and rugose form as in the nominate race. The only colouration variation is the presence or absence of the dorsal blotches being present as an irregular cross-banding in the type and very faint to absent in the two paratypes.

TYMPANOCRYPTIS LINEATA LINEATA Peters.

Tympanocryptis lineata Peters, 1863, p. 230; Boulenger, 1885, p. 392; Lucas and Frost, 1896, p. 131.

Tympanocryptis lineatus Waite, 1929, p. 113.

Tympanocryptis lineata centralis Sternfeld, 1925, p. 234; Loveridge, 1934, pp. 325–326.

Form stout; head longer than broad with angulate supraciliary and canthal ridges. Nostril oval, directed forward and slightly downward; pierced in the upper half of an enlarged nasal shield just below the canthus rostralis, being midway between or slightly nearer the eye than the tip of the snout. Upper head scales strongly keeled, tuberculate and slightly spinous, there being 10–13 between the supraciliary ridges. Upper labials 12–16 with 4–5 rows of scales separating them from the nasal shield. Body strongly depressed, covered dorsally with heterogeneous scales the majority of which are strongly keeled; intermixed irregularly with large erectile strongly mucronate tubercles of the type figured; ventral scales smooth or slightly keeled, uniform and directed away from centre. A strong transverse gular fold present; a further strong fold of outstanding tubercles extends from the angle of the mouth toward the shoulder, thus making the neck appear wider, when viewed dorsally, than it actually is. In Northern and Central Australian specimens this fold is much weaker and the head narrows down more sharply at the neck. Axilla-groin fold absent. Limbs moderate, covered with slightly mucronate, strongly keeled scales; when adpressed the hind limb reaches to the tympanum depression or slightly less in some female specimens. Sixteen and ten to eleven spinous bicarinate lamellae under the fourth and third toes respectively. Preanal pores present, 1+1.

Colouration. Light grey-brown dorsally with two rows of chocolate brown quadrate spots, one on either side of the vertebral line, sometimes uniting to form transverse bands. Three longitudinal white lines are prominent, although often visible only where passing through the chocolate markings. In some specimens, notably those taken to the southward around Adelaide, the lines are continuous, the vertebral line running along a series of non-tubercular and often non-keeled

scales. Two light bands cross the head—a prominent one between the supraciliary ridges and another not so obvious and sometimes dispersed band across the nape. From above the posterior corner of each eye one arm of a chocolate chevron-shaped band extends toward the nape. This band is usually broken centrally. Ventral surfaces white with a few brown spots present on the gular and chest regions of some male specimens. The tail has twelve transverse chocolate bands.

Measurements. Adult male, S.A.M. R2417.

Total length : 109 mm.
Body length : 29 mm.
Tail length : 65 mm.
Head length : 15 mm.
Head width : 11·5 mm.
Fore limb : 20 mm.
Hind limb : 30 mm.

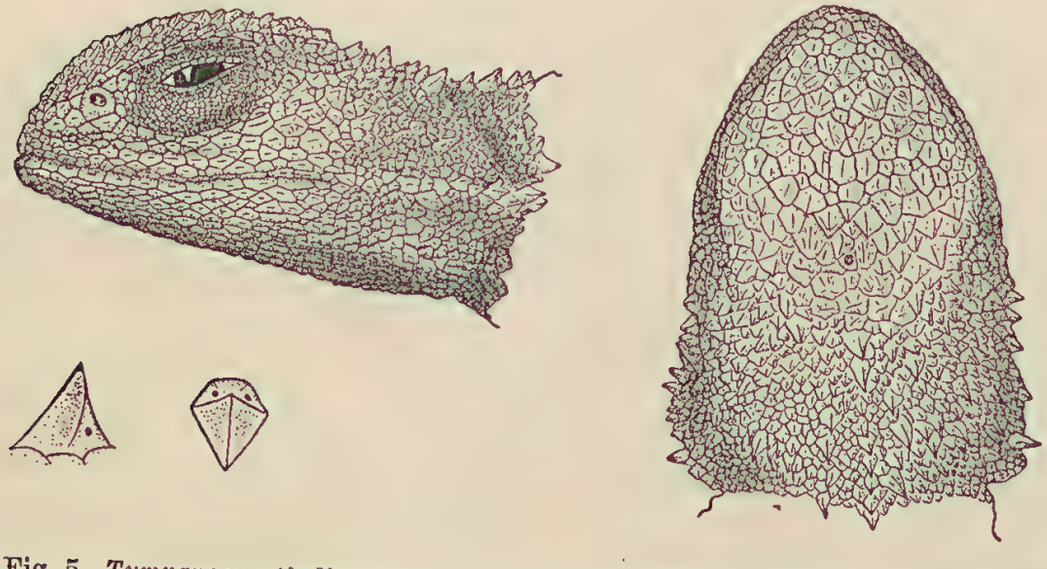


Fig. 5. *Tympanocryptis lineata lineata*: dorsal and lateral views of the head (×3) and a spinous dorsal tubercle (×5) of a typical specimen—S.A.M. R2417.

Distribution. Present locality records will not allow a detailed study of the distribution, but this form occurs most prominently throughout southern South Australia, being particularly common on the Nullarbor Plain. It also occurs northward around the *intima, maculosa, tetraporophora* distribution into the Northern Territory. A single specimen has been taken in the extreme south-west corner of Queensland and another at King's Sound in North Western Australia. Records have also been made of its presence near Mildura, Victoria, from which there is a gradual intergradation toward the Southern Victorian race *pinguicolla*.

Loc. South Australia: Buckleboo (S.A.M. R2417); Murat Bay (S.A.M. R2419); Sturt Creek (S.A.M. R2395); Hectorville (S.A.M. R787); Hughs (S.A.M. R1017); between Oodnadatta and Todmorden (S.A.M. R591); Lake Callabonna (S.A.M. R2429); Adelaide (S.A.M. R2435); Blakiston (S.A.M.

R2438); Tumby Bay (S.A.M. R1857); Port Noarlunga (S.A.M. R2133); Wynbring (S.A.M. R875); Kingoonya (S.A.M. R988); Tarcoola (S.A.M. R1010); Koonibba (S.A.M. R1487); Sutherlands (S.A.M. R1517); Purnong (S.A.M. R553); Fifth Creek, Montacute (S.A.M. R2538); Kirton Point (S.A.M. 2539); Ooldea (A.M. R7666); Port Lincoln (A.M. R4904); South Australia (S.A.M. R1068, A.M. R5631, R5630); Central Australia (A.M. R2106, S.A.M. R2418). Northern Territory: Macdonald Downs (S.A.M. R1617); Coniston Station (S.A.M. R1694); Hermannsburg (S.A.M. R1535, R1559); Macdonnell Ranges (S.A.M. R319); Banka Banka Station (A.M. R12010–360). Queensland: Diamantina Creek (S.A.M. R1593). Western Australia: King Sound (M.M. R930).

Records have been made in South Australian Museum registration lists of specimens taken at Lake Phillipson, South Australia, and Mildura, Victoria. Loveridge (1934) had a specimen from Forrest, Western Australia, and Kinghorn (1945) records a specimen in a collection of *T. intima* from 4 miles east of Camp 49, Simpson Desert Expedition.

There now seems little doubt that Peters used a specimen of this race in his type description. When dealing with the rare *Tiliqua adelaidensis* Peters, Waite (1929) cast some doubt on the locality data "Adelaide, South Australia," from which collection the type of *lineata* was also taken. In view of the fact that no further specimens of the *Tiliqua* had been collected in the sixty-five years that had elapsed since its description, Waite concluded that either the locality data was incorrect, or else *adelaidensis* had been described from a young specimen of one of the larger species. However, further specimens of this rare species have now been taken near Adelaide and a redescription is to be published later.

Considering the diversity of environment between the various habitats within the geographic range of this species the amount of variation is small. As already mentioned the degree of prominence of the angle of the mouth skin fold varies geographically, being most prominent in southern specimens and those transitional between *lineata* and the race *pinguicolla*. The tubercle shape is also fairly constant, although Northern Territory specimens have a much larger, more elongate tubercle form, with a blunter spine. The ventral and gular scales are keeled or smooth indiscriminately, both conditions occurring in specimens of the one sex taken together in a single collection.

With the exception of two specimens (S.A.M. R318) from the Northern Macdonnell Ranges, the colouration is also comparatively uniform, the greater majority of the specimens complying with the colour pattern already described. The outer-lateral white lines are generally absent, and there is some slight variation in the number of tail bands, the figure generally being twelve, but a range of 11–13 has been noted. Sometimes the bands are dispersed or united making a

greater variation, but specimens with an abnormal colour pattern have not been included in the variation recorded.

The above-mentioned Northern Macdonnell Range specimens have several peculiarities which suggest that a detailed examination of further specimens from this upland area may reveal the presence of a population worthy of recognition. These two specimens resemble typically coloured *tetraporophora* in the absence of longitudinal lines, and in having a light grey ground colour traversed by darker grey bands on the back and tail; also in the presence of 5–7 scales separating the nasal from the upper labials. They differ, however, in the much stouter habit and pores 1+1. The dorsal tubercles of these specimens are raised, but only bluntly keeled and non-spinous.

TYMPANOCRYPTIS LINEATA PINGUICOLLA subsp. nov.

Tympanocryptis lineata Lucas and Frost, 1894, p. 50; McCoy, 1889, p. 297, **pl. 181.**

Form stout with short robust limbs, the adpressed hind limb not reaching the shoulder; foot and digits stumpy, lacking the long thin narrow palm and fourth finger of the typical race; tail swollen at the base. Forelimb podgy with short thick digits; when adpressed forward barely reaches the tip of the snout. Head a little longer than broad with angulate supraciliary and canthal ridges. Nostril oval, directed sharply forward and downward; pierced in the upper half of an enlarged nasal, which is separated from fourteen upper labials by four rows of scales. Body depressed, covered dorsally and laterally with small rounded heterogeneous scales, the majority of which are sharply keeled; intermixed irregularly with very elongate wrinkled tubercles of the shape figured, these being more numerous than in typical *lineata*. In the extreme, the height of these tubercles is twice the basal length. Transverse gular fold present; angle of the mouth fold present or absent dependent on the state of the fat bodies—in the type it is absent, the neck being swollen out wider than the head, the only remaining indication of the fold being a row of tubercles which in *lineata lineata* is at the apex of the fold. Axilla-groin fold absent in the type, but strongly present in the majority of specimens. Limbs and tail short, covered with large keeled scales which tend to form uniform ridges. Gular and ventral scales uniform and smooth. Sixteen and ten spinous bicarinate lamellae under the fourth and third toes respectively. Pores small, almost indistinguishable, being partially hidden under the strongly imbricate ventrals—preanal only, 1+1.

Colouration of the type. Very badly faded owing to long preservation, but apparently near typical *lineata* colouration with very prominent dark edged, discontinuous vertebral and dorso-lateral lines; faint outer-lateral lines are

present. Without ventral markings. General ground colouration too badly faded to warrant description.

Colouration of a typical south-eastern Victorian specimen. Very similar to the typical race, but differing in the presence of outer-lateral white lines coinciding with the axilla-groin fold, and in the continuous nature of the dorso-lateral lines in the majority of specimens. The dark sinuous ventral mottlings on the chest and throat are more conspicuous.

Measurements. Holotype male, S.A.M. R2468a.

Total length: 115+ mm.	Head length: 18 mm.
Body length: 43 mm.	Head width: 16 mm.
Tail length: 54+ mm.	Fore limb: 22 mm.
Maximum width of neck: 18 mm.	Hind limb: 35 mm.

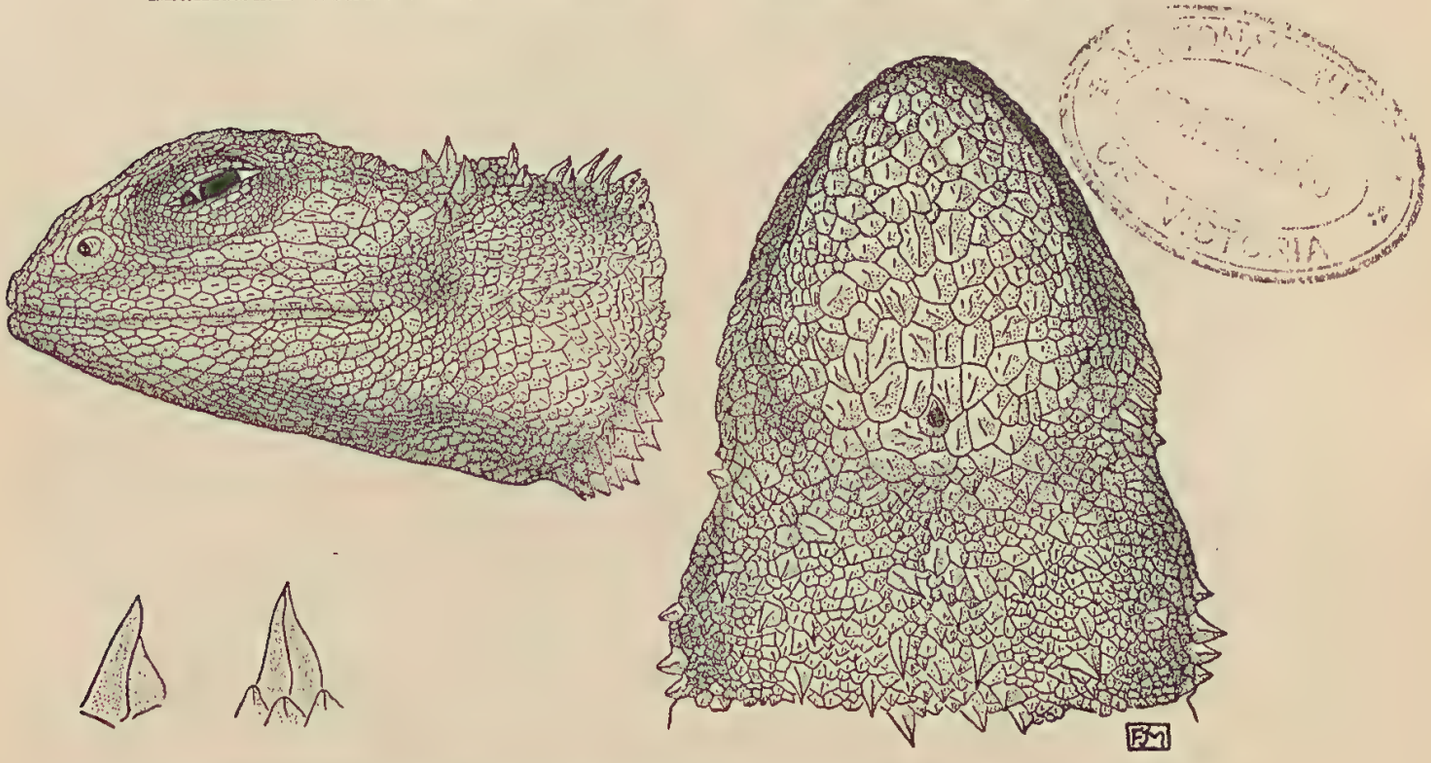


Fig. 6. *Tympanocryptis lineata pinguicolla*: dorsal and lateral views of the head (×3) and an enlarged dorsal tubercle (×5) of the holotype male.

Loc. Victoria: "Southern Victoria" (S.A.M. R2468, type specimens); Essendon (N.M. D1848, D1849, D7702); mouth of the Yarra River (N.M. D3482, D3483); Werribee (N.M. D1338, D1339); Victoria (A.M. R2054). New South Wales: Cooma (A.M. R3872).

Further Victorian localities recorded by Lucas and Frost (1894) under *lineata lineata* are Salt Water River, Maryborough and Rutherglen. Also recorded from Sunbury, Victoria, by McCoy (1889).

Owing to the large area of intergradation between this race and its nominate form, a detailed examination for variation is impracticable, the majority of specimens so far collected being at some stage intermediate between typical *lineata* and the extreme *pinguicolla*. It is not until southern localities around Melbourne are reached that any constancy is evident. The specimens here, although showing the very stout features, short limbs and elongate tubercle form, have not reached the extreme condition seen in the types. All specimens so far taken within a 100 mile radius of Melbourne have proved good and easily distinguishable examples, and can be regarded as typical of the race. The various characteristics of this subspecies are admirably shown in some excellent figures by McCoy (1889, pl. 181) of specimens taken near Essendon, Victoria.

Another prominent factor is the presence of an axilla-groin skin fold coinciding with the outer-lateral white line. This fold acts as an absolute division between the heterogeneous dorsal and the uniform ventral scales. In typical *lineata* this fold is absent, and the dorsal and ventral scales gradually intergrade. This fold is present in all specimens so far examined from the Melbourne area, and also in the two Australian Museum specimens from Cooma, New South Wales. It is, however, absent from the three type specimens. The thick neck, tail and body appear to have been caused by the building up of fat bodies, an X-ray examination having failed to show any skull modification to cause the abnormally thickened neck. It is probable that the colder prevailing conditions and more abundant food has led to the building up of fat storage to tide over the long winter in these southern areas. This fat storage suggests a reason for the inconstant presence of the skin folds, these being absent owing to contained fat early in the season, and present in specimens taken later in the season.

TYMPANOCRYPTIS LINEATA TETRAPOROPHORA Lucas and Frost.

Tympanocryptis tetraporophora Lucas and Frost, 1895, p. 265; 1896, p. 131.

Form moderate to slim; head almost once and a half times as long as wide; nostril round or slightly oval, directed forward and downward; pierced in an enlarged nasal just below an acute canthal ridge; nostril slightly nearer the anterior corner of the eye than the tip of the snout; separated from 15–17 upper labials by six or seven rows of scales. A minority of the upper head scales are tuberculate; 11–14 separate the supraciliary ridges. Body strongly depressed, covered dorsally with heterogeneous scales, the majority of which are feebly keeled; intermixed irregularly with elongate spinous tubercles of the form figured. A strong transverse gular fold present; angle of the mouth fold feebly present or absent, generally absent; axilla-groin fold absent. Limbs, as with the body and head, very elongate, and when adpressed the hind limb reaches to the eye or

beyond in males, and to the tympanum depression in females. Palm of foot very elongate with long digits, there being 19–21 and 12–14 spinous bicarinate lamellae under the fourth and third toes respectively. One femoral and one preanal pore present on either side in both sexes.

Colouration of the typical form. Ground colour grey-brown with the usual pairs of quadrate spots, which are sometimes fused to form dark grey, verging black cross-bands. No upper head markings. Tail with 12–14 transverse darker cross-bands. The dorso-lateral and vertebral lines are also present in many specimens as darker or lighter streaks. Under surfaces white; the chest and gular region in the male is often minutely dotted with brown.

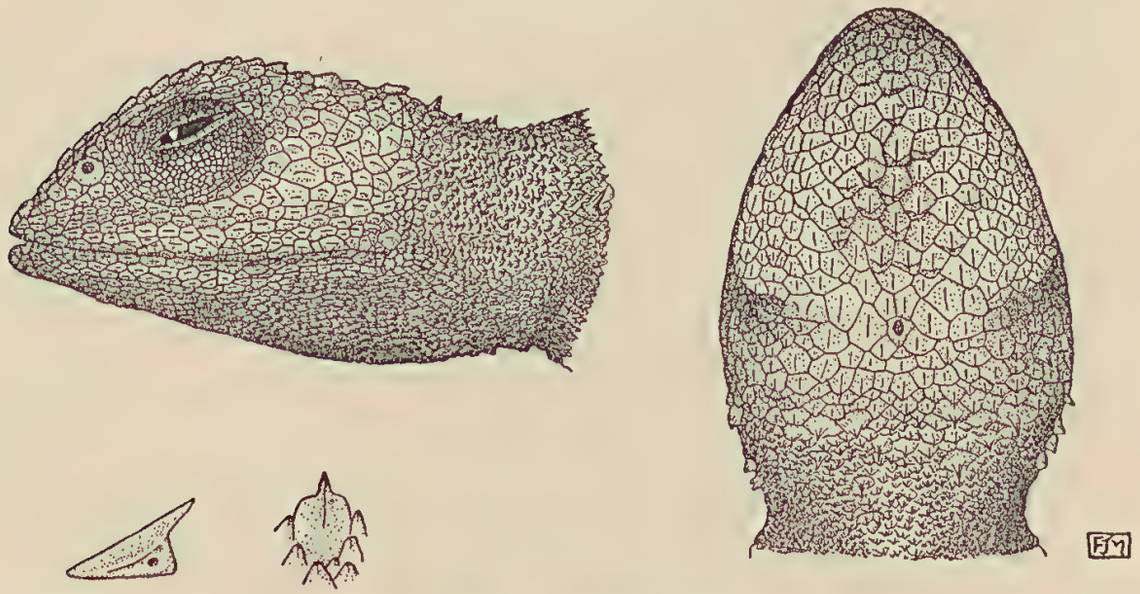


Fig. 7. *Tympanocryptis lineata tetraporophora*: dorsal and lateral views of the head (×3) and an enlarged dorsal tubercle (×5) of a typical male specimen—S.A.M. R2444.

Colouration of the Northern Flinders Range form. Dorsal and dorso-lateral surfaces uniform light grey without quadrate spots or longitudinal lines. Tail with 12–14 faint darker grey bands.

Colouration of small intermediatary groups. These possess near typical *lineata* colouration with slightly smaller quadrate spots and additional tail bands. With the exception of the brilliantly coloured Southern Flinders Range specimens, whose colouration will be discussed later, specimens of these groups have no upper head markings.

Measurements. Typical male, S.A.M. R2444.

Total length: 152 mm.
Body length: 37 mm.
Tail length: 97 mm.
Head length: 18 mm.
Head width: 13 mm.
Hind limb: 43 mm.
Fore limb: 26 mm.

Distribution. Owing to the state of collection this is somewhat uncertain, but appears to be discontinuous throughout the greater part of Eastern and Southern Australia, and in some way correlated with the presence of hilly country.

Loc. South Australia: Abminga and Dalhousie (N.M. D7701); 20 miles north of Macumba Creek (S.A.M. R2444); Mt. Serle (S.A.M. R1285); Innaminka Hills (S.A.M. R2420); Northern Flinders Ranges (S.A.M. R2494, R2448); Indulkana Ranges (S.A.M. R590); Marree (S.A.M. R212); near Marree (S.A.M. R2449); Mern Merna (S.A.M. R2605); Warcowie (S.A.M. R2580); Finniss Springs (S.A.M. R2525, part); 4 miles south-west of Marree (S.A.M. R2598, part). Central Australia: (N.M. D5397, D5398, S.A.M. R2428, A.M. R2107, R4883, R4885, R4886, R2108). Northern Territory: Charlotte Waters (N.M. D3485, D3484). Queensland: Hughenden (A.M. R10108, R10107, R10106); 15 miles south-west of Urandangi (A.M. R10306.17); Wangarie Richmond (A.M. R5000); Muttaburra (A.M. R3336); 8 miles west of Winton (A.M. R10308). Western Australia: Eyre Sand Patch, Hampton Range (S.A.M. R2415). New South Wales: Broken Hill (A.M. R9833, S.A.M. R2425); Silverton (S.A.M. R2500); Moree (A.M. R1828); Darling River (A.M. R5650).

The reinstatement of this form rests upon a detailed examination of all available four-pored specimens and their habitats. The conclusion is that this group is worthy of recognition taxonomically, and that the additional pores and other factors are not individual variations as was apparently suspected by Lucas and Frost (1896). Other characters correlated with the additional pores tend to verify this conclusion. It has been found that all specimens with four pores have:

(a) a very elongate form.

(b) a constant position for the nostril, this differing from that of *lineata lineata* in having a greater number of scales separating it from the upper labials.

(c) a comparatively constant and definite tubercle shape.

Further, all specimens with the additional pores have been taken in a hilly environment. Thus we have a series of localities all involving hills or ranges. Lucas and Frost doubted the validity of their *tetraporophora,* principally on the grounds of colour variation, as some specimens had been found with colouration closely resembling that of *lineata lineata.* It is evident now that the colouration varies not only from population to population, but also within a single population in the case of large areas where there is an appreciable environment or altitude change. In the two main distributional areas, viz., the Flinders Ranges and the

Abminga-Dalhousie-Indulkana Range areas, such conditions are present. It is probable that as further specimens are collected from the western slopes of the Great Dividing Ranges in Queensland and New South Wales, that such a condition will be found there also; specimens from Hughenden, Queensland, exhibit colouration more uniform and drab than those taken from further out at Richmond and Winton in the same State.

The type and other specimens from the Abminga-Dalhousie area have typical colouration as already described, while specimens taken on the outskirts of the area delineated, are at intermediate stages between this and typical *lineata* colouration.

Such specimens of the Horn Expedition material as are available have been examined, and all have been found to be intermediatarily coloured *tetraporophora*, although Lucas and Frost (1896) recorded three localities within the apparent range of *tetraporophora* from which "typical" *lineata* were taken. The examined Horn specimens are without accurate locality data, and it is not possible to determine which, if any, of them were regarded by Lucas and Frost as "typical" *lineata*. It is possible that they did not critically examine their specimens for the additional pores and because of their colour assumed them to be *lineata lineata*. This is supported by the fact that in many female specimens the additional pores cannot be distinguished with the unaided eye, and without microscopic examination it would have been logical to conclude that a specimen of this nature, with typical *lineata* colouration was *lineata lineata*. Again, one of the localities from which Lucas and Frost recorded typical *lineata* is the type locality of *tetraporophora*, viz. Dalhousie. This indicates either definite overlap in distribution or else pronounced interbreeding between the two forms, if these specimens were only bi-pored.

A similar combination of characters is found in examples from the Flinders Ranges, South Australia. A number of specimens taken near Mt. Serle, have a uniform drab colouration of dull grey which is unbroken by longitudinal lines or quadrate spots, the only variation being faint caudal banding. From the Southern Flinders Ranges several excellent collections have been received from the vicinity of Mern Merna and Warcowie. These consist entirely of four-pored specimens, all of which have a brilliant and unique colour pattern even more striking than typical *lineata* colouration. The dorso-lateral white lines extend to the neck and on to the head, the outer-lateral lines being present and prominent, continuing along the cheek in many specimens. The dorso-lateral lines are unbroken and expand on reaching the nape to about twice their original width, extending along the head to a position above and just behind the eye. The vertebral white line also extends to the nape, but does not dilate appreciably, nor does it reach as far as the outer-lateral lines; there are no further markings

on the head. In some specimens exhibiting a brick-red ground colour the dorso-lateral lines have darkened to a dull grey, although they are still prominent.

Although the scalation and proportion of all populations are approximately constant, it can be seen from the above that the major isolated populations have developed some colour peculiarities. The smaller populations inhabiting low hills where there is little variation in environment, have a uniform colour pattern closely resembling that of *lineata lineata*, although generally lacking the upper head markings. Such populations occur at Hampton Range, Western Australia; Hermit Range, South Australia; Barrier Range, New South Wales; Urandangi area, Queensland, etc. A single specimen, said to have been taken in the Innaminka Hills, South Australia, has a uniform colouration resembling that of the Northern Flinders Range specimens.

It is difficult to decide the status of this group until its position has been analyzed in the field. Considering only its structural resemblance it has been placed as a race of *T. lineata*. Critically there are almost equal grounds for placing it with either *cephalus* or *lineata*, for it exhibits definite affinities with both. The position of the nostril and the number of scales separating it from the upper labials are definitely near *cephalus*, while the general form, colouration and to some extent scalation point to a relationship with *lineata*. As will be discussed later, a possible explanation to its affinities with both species is that it is an ancestral form.

The association of this race with *lineata* was influenced principally by the fact that if it was discontinuously isolated by interbreeding, as present evidence suggests, then it can only interbreed with its present surrounding populations of *lineata*. To have any direct connection with *cephalus* under these circumstances, *cephalus* would have to be regarded as a race of *lineata*, a doubtful assumption on recent distributional evidence.

The suggestion is made that the four-pored material represents an archaic and at present static race, which is existing in small ecological niches in and around hill and range country, where the open plain dwelling *lineata lineata* is less likely to encroach on it. This is supported by its present ecologically diverse distribution with little somatic change.

TYMPANOCRYPTIS UNIFORMIS SP. NOV.

Form very stout; head almost as wide as long; the angular canthus rostralis together with the flat dorsal surface of the snout, give the head a "sliced" appearance. Nostril oval, directed forward and downward; pierced in the upper half of a slightly tubular nasal shield, being a little nearer the tip of the snout than the eye. Upper head scales only slightly enlarged, flat, and keeled; about

sub-equal in size to the enlarged dorsal scales. Body stout and not markedly depressed; covered dorsally and laterally with keeled heterogeneous scales. No enlarged dorsal tubercles, their place having been taken by simple mucronulately keeled scales, which are but slightly raised above the normal dorsals, being little noticed without critical examination. Several small conical tubercles are present on the nape. Ventral and gular scales feebly keeled. Limbs short and weak; when adpressed the hind limb reaches to the shoulder. The tail is short and

Fig. 8. *Tympanocryptis uniformis*: dorsal and lateral views of the head (×3) and an enlarged dorsal scale (×5) of the holotype specimen.

tapers rapidly to a fine point, its length being a little longer than the combined head and body measurements. A strong transverse gular fold is present while the angle of the mouth fold and its attendant tubercles are absent; axilla-groin fold absent. Preanal pores 1+1, barely visible. Sixteen and nine bicarinate and strongly spinous lamellae under the fourth and third toes respectively. The eyes protrude beyond the supraciliary ridges, making the upper and lower eyelids very convex.

Colouration. Somewhat faded in spirit, but apparently a uniform blue-grey dorsally and dirty white ventrally, both surfaces lightening posteriorly. There are faint indications of transverse caudal banding.

Measurements. Holotype, S.A.M. R705.

Total length: 114 mm.
Body length: 33 mm.
Tail length: 65 mm.
Head length: 16 mm.
Head width: 15 mm.
Fore limb: 25 mm.
Hind limb: 33 mm.

Distribution. The type and only specimen was taken near Darwin, Northern Territory, by P. Wesselmann, June, 1911.

To date this peculiar lizard is the stoutest form described, and its squat rotund body, short tail and limbs, together with the relatively uniform scalation, contrast sharply with the other strongly depressed and irregularly scaled members of the genus.

TYMPANOCRYPTIS MACULOSA sp. nov.

Form moderate, head short; nostril below an ill-defined canthus rostralis and slightly nearer the tip of the snout than the anterior corner of the eye; pierced centrally in an enlarged nasal, which is separated from fifteen upper labials by 3–4 rows of scales; the actual nostril aperture is a slit in the bottom of an oval nasal cavity, being directed just forward of vertically downward. Dorsal and

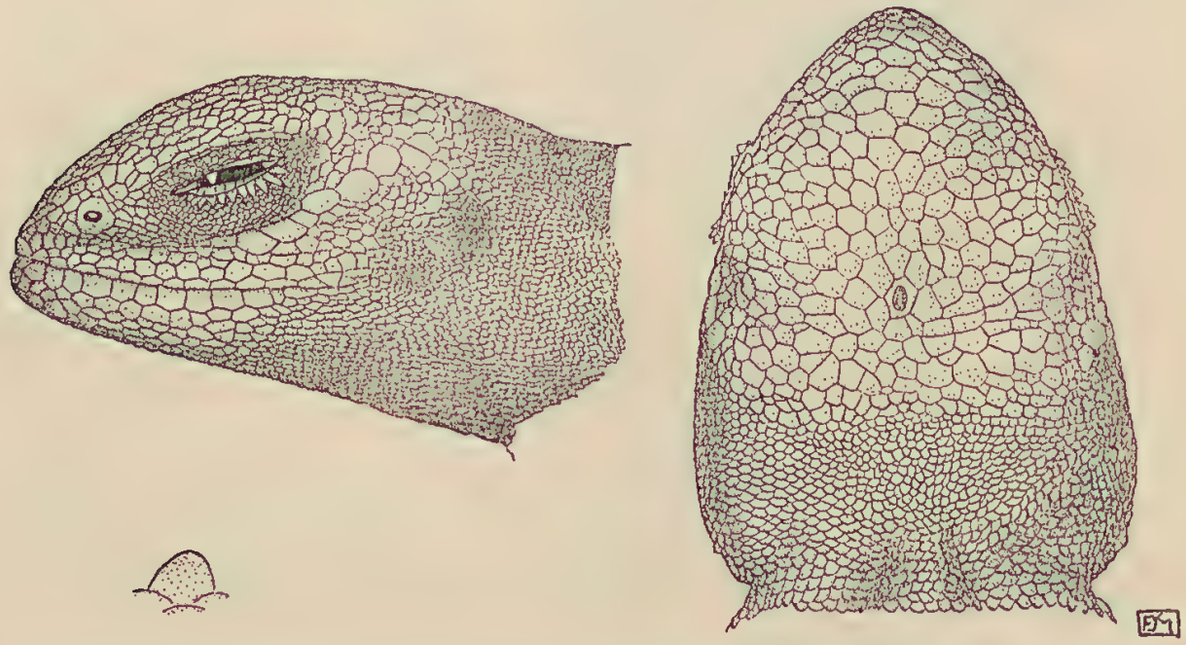


Fig. 9. *Tympanocryptis maculosa*: dorsal and lateral views of the head (×3) and an enlarged dorsal scale (×5) of the holotype male.

lateral scales smooth, non-imbricate and heterogeneous, being intermixed with slightly enlarged flat plates, which become weakly tuberculate laterally. Ventral scales smooth and uniform, slightly imbricate, directed away from centre; gular and anal scales small, tending granular; caudal scales show slight keels toward the tip of the tail. Upper head scales flat and smooth, 18–20 between the supraciliary ridges. The adpressed hind limb reaches to the tympanum depression which is very prominent. A strong transverse gular fold is the only skin fold present. Another prominent feature of this species is a row of enlarged tubercular scales which extend from under the eye to above the tympanum depression.

Six femoral pores on either side including one in each groin; a single pore is present just within the preanal region in the holotype specimen; extending almost the full length of the thighs. In the female allotype the pores occur as minute depressions in modified scales. Eighteen and eleven unicarinate spinous lamellae under the fourth and third toes respectively.

Colouration. Dorsal surface white to very pale grey with a row of five very dense black blotches on either side of the vertebral line; the two rows coalesce toward the tail; a few small spots are also present along the vertebral line. Ventral surfaces white; a black streak extends longitudinally along the centre of the throat as far as the gular fold. The black markings are less pronounced in the allotype female.

Measurements. Holotype male, S.A.M. R2220a.

Total length: 135 mm.	Head width: 15 mm.
Body length: 55 mm.	Fore limb: 27 mm.
Tail length: 80 mm.	Hind limb: 38 mm.
Head length: 19 mm.	

Distribution. Twenty specimens of this unusual species were taken by the late Dr. C. T. Madigan in his expedition on to the surface of Lake Eyre North, in August to December, 1929. In his report he mentions them as occurring on the four mile wide marginal area of the lake.

Loc. South Australia: Lake Eyre North, holotype, allotype and paratypes, S.A.M. R2220.

This unique species is one of the most specialized Australian lizards and is an excellent illustration of selective adaption to a special environment. In this barren habitat one immediately wonders as to the food of these lizards. An examination of the stomach contents has revealed it to consist mainly of small harvest ants (*Melophorus* sp.) which apparently feed on the numerous seeds which are blown out over the lake, or alternatively, as was suggested by Madigan (1930), on micro-organisms in the salt. The seeds also appear to have formed some part (accidental or otherwise) in the diet of the lizards, as several of the stomach contents examined, contained seeds in various stages of digestion. Another query which introduces itself is that of shelter on this flat non-vegetative plain, but Madigan mentions in his report that the lizards were found burrowing in dry sand deposits and under the buckled salty crust.

In the above-mentioned report (Madigan, 1930), these lizards were identified as *Tympanocryptis lineata* var. by Mr. H. M. Hale, present Director, South Australian Museum. Hale, although pointing out the unique colouration and smooth scalation, did not note one other important difference, viz. the presence of a series of femoral pores. This, together with the scalation and colouration

differences already enumerated, are ample grounds for its complete specific separation.

As with the majority of species in this genus, the specimens of this species so far examined show remarkably uniform characters, the only variation worthy of notice being that in some specimens, the "enlarged" plates are so nearly subequal to the normal dorsals that their presence can be disregarded. The only colour variation is the less prominence of the darker markings in female specimens.

TYMPANOCRYPTIS LINEATA CENTRALIS Sternfeld.

As already noticed by Loveridge (1934) the grounds upon which Sternfeld based this race are slender, his principal distinguishing feature being the greater relative length of the tail, which in his type is 1·7 times the snout-vent length, as against 1·1 times in a specimen of *lineata*, the measurements of which were given by Boulenger (1885). The average ratio of typical *lineata* specimens is approximately 1·5, which would be about equal to the average for the eight co-types of *centralis*. According to Loveridge (1934) the figure for these is 1·2–1·5 in the females and 1·5–1·6 in the males.

In response to a request, the British Museum authorities kindly checked the measurements of Boulenger's specimen, and this revealed that the tail was probably incomplete. It is interesting to note that the ratio for a second specimen in the same collection whose measurements were also provided is 1·5.

An examination of six specimens from the Hermannsburg district has supplied no further support for the formation of this race. All six specimens have typical *lineata* scalation, and specimens taken near the mission station itself have typical colouration. Specimens taken to the north of Hermannsburg toward the Macdonnell Ranges, however, have less prominent dorso-lateral lines, and the quadrate spots tend to form transverse bands. A specimen of this nature may have been described by Sternfeld as a type. In these six specimens the snout-vent into tail ratio averages 1·6.

Loveridge (1934) mentions one other character in connection with *centralis*, viz. the presence or absence of keeled ventral scales. This has been found very inconsistent, the two conditions often being found in specimens of the same sex taken in a single collection.

KANGAROO ISLAND RECORDS.

In his British Museum Catalogue, Boulenger records a specimen of *Tympanocryptis* from Kangaroo Island, South Australia (B.M. Reg. No. 56.1.9.6). In reply to a request for further information the British Museum authorities stated that they had no further data other than that the specimen was presented by the

Zoological Society of London. Other than this one record, no others have been made for the genus on this or any other insular area about Australia and I am inclined to consider that there has been some confusion with regard to the locality of this specimen.

In 1927 the Fauna and Flora Board of S.A. made a survey of the fauna of Kangaroo Island and were also unable to locate any further specimens, Waite in his report (1927) merely referring to the British Museum Catalogue record. In January of the following year, soon after completing the manuscript of his Reptile Handbook, Waite died. Unless he obtained further records for the genus between October, 1927, and his death, the reference in his handbook to *T. lineata* as "not uncommon on Kangaroo Island" appears to be a generalization based on the single British Museum record.

PROPORTIONAL ELONGATION.

During the preliminary hunt for concrete distinguishing factors it was thought that the elongation of some forms may have been accompanied by some increase in vertebrae numbers. Consequently a small number of each were X-rayed. As a result it was found that there was no difference in the number of body vertebrae, the only variation being in the proportions of each component. The number appears to be constant at 22–24, generally 23. The tail vertebrae, however, vary considerably, 42 being about the average, but some specimens of *tetraporophora* have 50, while in some of the shorter tailed species *cephalus* and *uniformis* the count falls to 35. The actual ranges are: *cephalus* and *uniformis* 35–40, average 38; *lineata* 38–44, average 42; *tetraporophora* 41–50, average 46; all other forms have a range between 38 and 45.

With regard to the proportion change of the individual body vertebrae, this is only noticeable in the extreme forms *cephalus* and *tetraporophora*. In *cephalus* a standard vertebra is almost once and a half times as wide as long, while in *tetraporophora* it is slightly longer than wide. The tenth vertebra in each case is taken as standard.

Another significant feature noticeable in the X-ray is the elongation of the skull and its consequent modification. The best diagnostic feature here revealed is the angle at which the lower jaws set themselves when closed. Here again the difference is only significant in the extremes. In *tetraporophora* it varies between 50′ and 55′, while in *cephalus* it ranges from 60′ to 65′. In the single specimen of *uniformis* it is about 70′.

This skull elongation, which can be taken as a representative factor in the general elongation of the whole animal, is shown graphically in the form of a

series of histograms (fig. 10). The three divisions of *tetraporophora* which overlap *lineata* are composed almost entirely of the small Southern Flinders Range group. Where there are sufficient specimens of the other forms it is apparent that they are all near *lineata* in this respect.

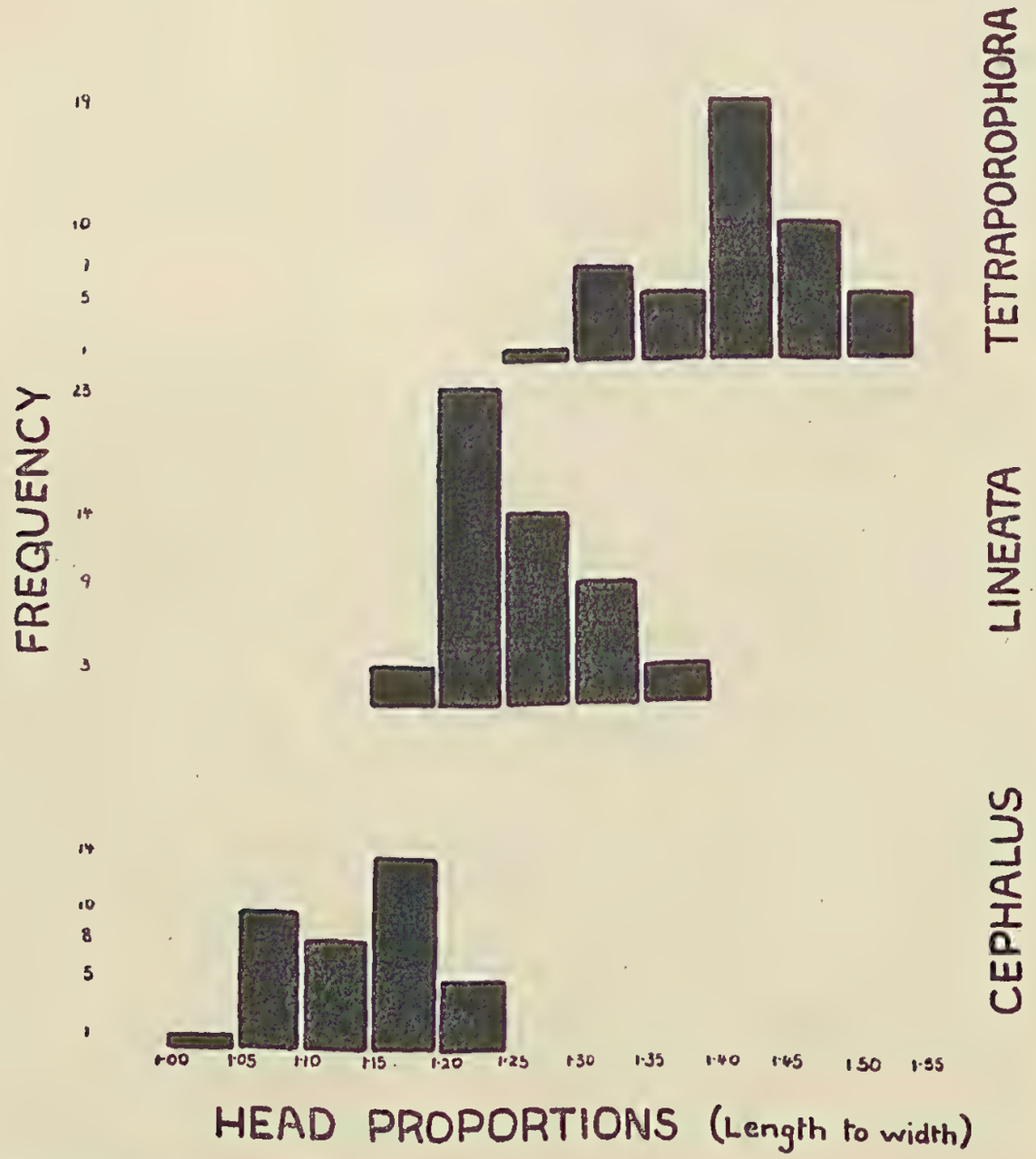
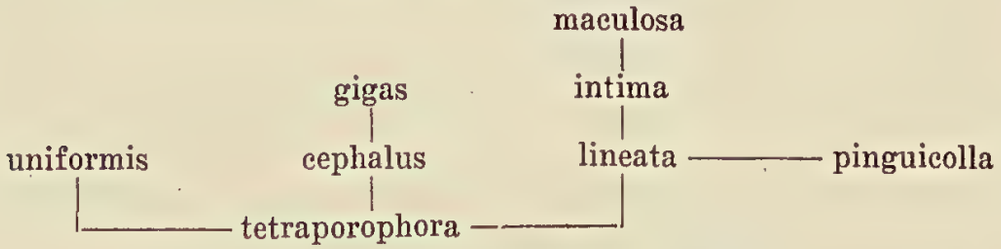


Fig. 10. Proportional elongation: the above results illustrated graphically in the form of a series of histograms.

RELATIONSHIPS.

Owing to the present incomplete knowledge of the distribution of many forms of the genus, the relationships cannot be determined with finality. Having regard to the geologically recent drying of Lake Eyre North and the Age and Area Hypothesis it would seem possible that the last species to become established was *maculosa*. By comparison with other forms it appears to be a modification or mutant of *intima*, the species which at present completely surrounds it, there being an apparent trend toward a reduction in the number and size of the enlarged tubercles and keels through *lineata* and *intima* to *maculosa*.



It is suggested, on available evidence, that a form resembling the present *tetraporophora* became differentiated into three species, viz. *cephalus*, *uniformis* and *lineata*. Further that *cephalus* has given rise to one race *gigas*, while two species and one subspecies are modifications of *lineata*. As has already been pointed out in the previous discussion on *tetraporophora*, the last named shows definite affinities with two of these possible major evolutionary chains—that of *lineata* and of *cephalus*. This further supports the hypothesis of both having arisen from a population closely akin to *tetraporophora* as at present recognized.

ACKNOWLEDGMENTS.

I wish to acknowledge assistance rendered in allowing me to examine specimens contained in Australian Museums as follows: Dr. A. B. Walkom and Mr. J. R. Kinghorn of the Australian Museum, Sydney; Mr. R. T. M. Pescott and Mr. C. W. Brazenor of the National Museum, Melbourne; Mr. L. Glauert of the Western Australian Museum, Perth, and Mr. J. Henry of the Macleay Museum, Sydney. Mr. G. Mack of the Queensland Museum, Brisbane, forwarded Queensland locality data. The British Museum authorities kindly provided data and photographs of type and other material in that institution. I have also to thank Dr. T. D. Campbell of the Dental Hospital, Adelaide, for the X-rays and Miss G. Walsh of the South Australian Museum for the photography.

My special thanks are due to Mr. J. R. Kinghorn and Mr. S. J. Copland, whose advice and encouragement proved invaluable.

BIBLIOGRAPHY.

Boulenger, G. A. (1885) : British Museum Catalogue of Lizards, 2nd. ed., i, p. 392, pl. xxxi, fig. 1.

Gunther, A. (1867) : "Additions to the knowledge of Australian Reptiles." *Ann. Mag. Nat. Hist.* (3), xx, p. 52.

Kinghorn, J. R. (1932) : "Herpetological Notes, No. 4." *Rec. Aust. Mus.,* xviii (7), p. 360.

Kinghorn, J. R. (1945) : "Reptiles of the Simpson Desert Expedition." *Trans. Roy. Soc., S. Aust.,* 69, i, p. 5.

Loveridge, A. (1934) : "Australian Reptiles in the Museum of Comparative Zoology, Harvard." *Bull. Mus. Comp. Zool.,* 77 (6), p. 325.

Lucas, A. H. S. and Frost, C. (1894) : "Lizards Indigenous to Victoria." *Proc. Roy. Soc., Vict.,* vi, p. 50.

Lucas, A. H. S. and Frost, C. (1895) : *Proc. Roy. Soc., Vict.,* vii, p. 265 (n. ser.).

Lucas, A. H. S. and Frost, C. (1896) : *Reptiles of the Horn Expedition,* ii, p. 131.

Madigan, C. T. (1930) : *Geographical Journal* (S. Aust), 76, p. 234.

McCoy, F. (1889) : *Prodromus Zool., Vict.,* ii, p. 297, pl. clxxxi.

Peters, W. (1863) : *Monatsb. Akad. Wiss. zu Berlin,* p. 230.

Simpson, G. G. and Roe, A. (1939) : Quantitative Zoology.

Sternfeld, R. (1925) : *Abh. Senckenb. Naturf. Gesell.,* 38, p. 234.

Stirling, E. C. and Zietz, A. (1893) : *Trans. Roy. Soc., S. Aust.,* xvi, p. 168.

Waite, E. R. (1927) : "Fauna of Kangaroo Island" (3)—Reptiles and Amphibians, *Trans. Roy. Soc., S. Aust.,* li, p. 326.

Waite, E. R. (1929) : Reptiles of South Australia, p. 113.

Zietz, F. R. (1915) : *Trans. Roy. Soc., S. Aust.,* xxxix, p. 769.

Zietz, F. R. (1917) : *Trans. Roy. Soc., S. Aust.,* xli, p. 470.

Zietz, F. R. (1920) : "Catalogue of Australian Lizards." *Rec. S. Aust. Mus.,* i, pp. 181–228.

TABLE OF THE STRUCTURAL DIFFERENCES.

Race	Dorsal Scales.	Ventral Scales.	Tubercle Shape	Pores.	Relative proportions	Tubercle Distribution.	Labial from Nasal separation.	Agle of Mouth Skin Fold.	Axilla-groin Skin Fold.	Tail Bands.
lineata	Majority strongly keeled	Feebly keeled or smooth	Vertically spinous	Preanal, 1+1	Moderate to stout, strongly depressed	Numerous, irregular, singly distributed	4–5 rows	Strongly present in majority of specimens	Absent	12–13
uniformis	All keeled	Keeled	Flat with simple keel	Preanal, 1+1, very small	Very stout	Flat and not noticeable without critical examination	4 rows	Absent	Absent	10 or 11, very faint
pinguicolla	Majority keeled	Feebly keeled or smooth	Very elongate, vertically spinous	Preanal, 1+1, very small	Stout, strongly depressed	Very numerous, irregular, singly distributed	4 rows	Present or absent when swollen	Strongly present	12
intima	Smooth	Smooth	Flat and spinous	Preanal, 1+1	Stout, depressed	Sparse, tending to form four longitudinal series	4–6 rows	Feebly present	Absent	10–12, often absent or dispersed
maculosa	Smooth	Smooth	Flat and smooth	Femoral, 5+5 average	Stout, depressed	Not noticeable without critical examination	3–4 rows	Absent	Absent	Absent
tetra-porophora	Feebly keeled or smooth	Smooth or feebly keeled	Raised and spinous	Femoral, 1+1 preanal, 1+1	Slim to moderate, strongly depressed	Numerous, irregular singly distributed	6–7 rows	Absent or feebly present	Absent	12–15
cephalus	Smooth	Smooth	Rugose, tending conical, slightly spinous	Preanal, 1+1	Stout, body strongly depressed	Numerous, irregular, distributed in clumps of two or more adjacent	6–7 rows	Absent or very feeble	Absent	8–10
gigas	Smooth	Smooth	Flat, with conical spine rising just forward of centre	Preanal, 1+1	Stout, very strongly depressed	Numerous, irregular, distributed in clumps of two or more adjacent	6–7 rows	Absent	Absent	8–10

EXPLANATION OF PLATES.

Plate iv.

Fig. 1. Holotype male of *Tympanocryptis lineata pinguicolla.*
Fig. 2. Typical male of *Tympanocryptis lineata lineata*—S.A.M. R2417.
Fig. 3. Holotype female of *Tympanocryptis intima.*
Fig. 4. Holotype specimen of *Tympanocryptis uniformis.*

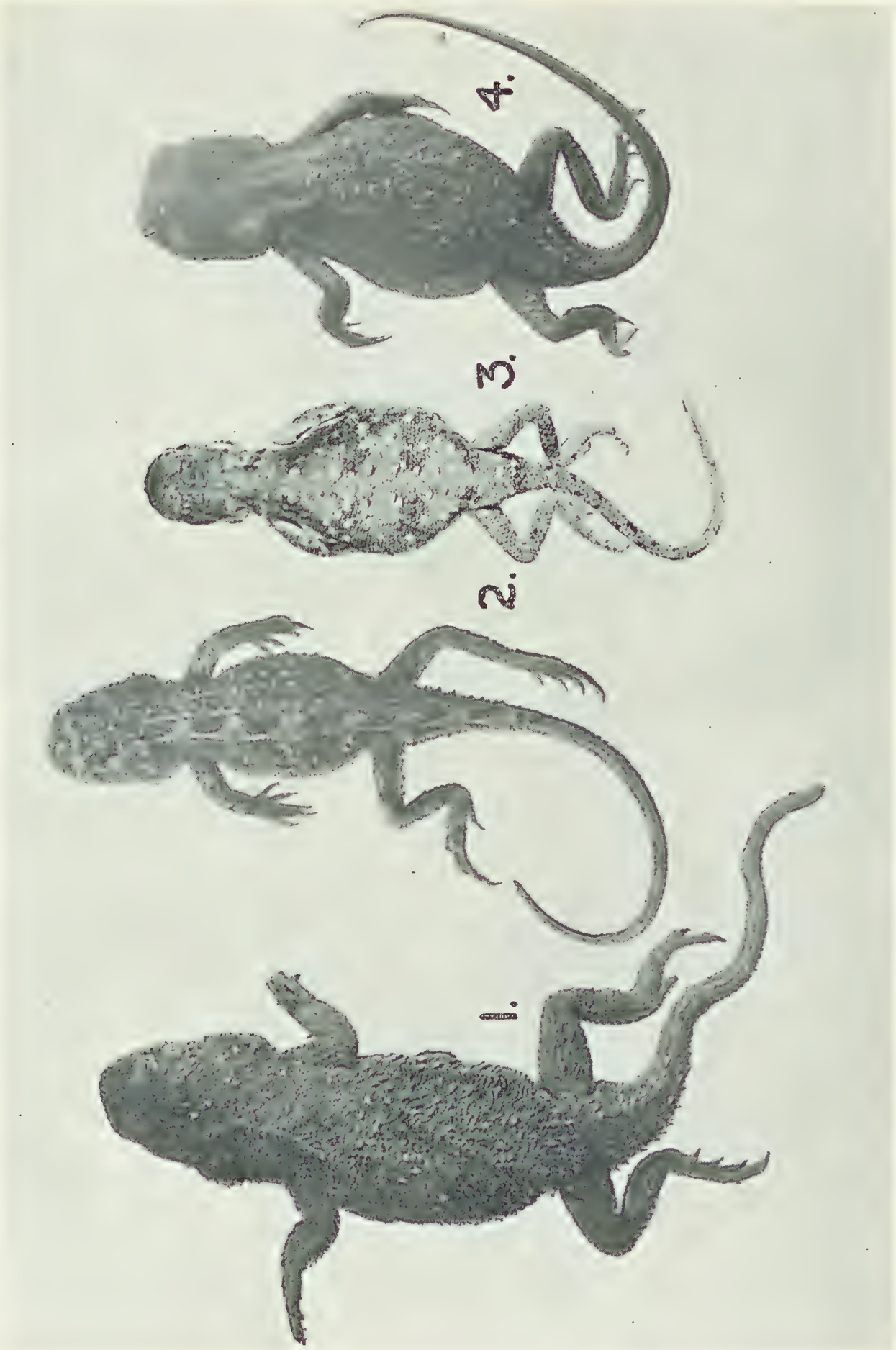
Plate v.

Fig. 5. Holotype male of *Tympanocryptis cephalus gigas.*
Fig. 6. Co-type specimen of *Tympanocryptis cephalus cephalus.*
Fig. 7. Typical inland male of *Tympanocryptis cephalus cephalus*—W.A.M. R7067.
Fig. 8. Holotype male of *Tympanocryptis maculosa.*

Plate vi.

Tympanocryptis lineata tetraporophora.

Fig. 9. Typical form.
Fig. 10. Low hill form.
Fig. 11. South Flinders Range form.
Fig. 12. North Flinders Range form.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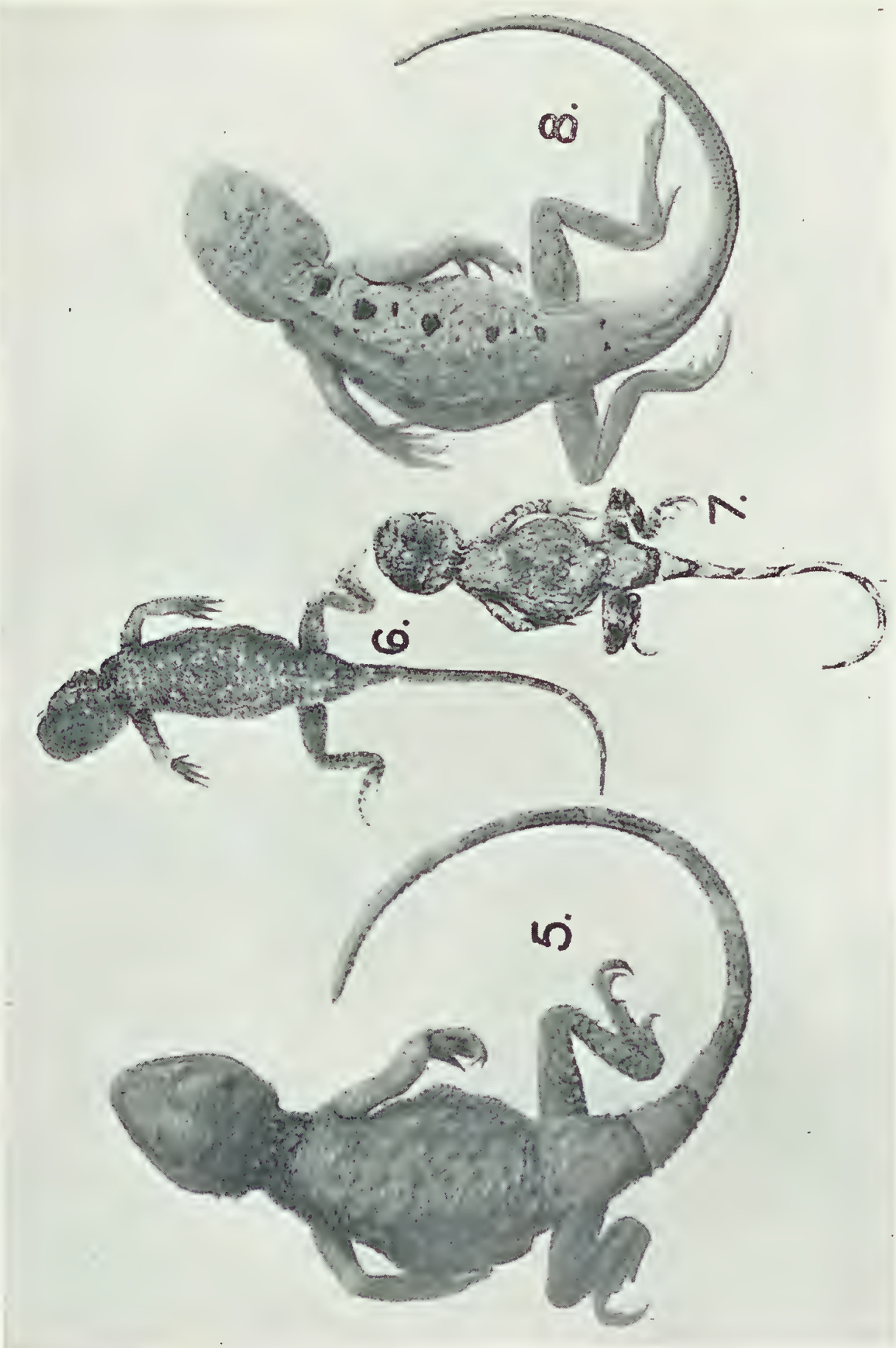
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A NEW CESTODE, *RAILLIETINA (R.) LEIPOAE*, FROM THE MALLEE HEN

By T. HARVEY JOHNSTON and HELEN GOLDTHORP CLARK,
University of Adelaide.

Fig. 1–12.

The present paper is based on South Australian material from two mallee fowls, *Leipoa ocellata* Gould (Galliformes, Megapodiidae), one of them taken by Mr. L. Ellis near Tailem Bend, and the other by Mr. P. Lawson, of the South Australian Museum staff, near Strathalbyn. From the former bird we obtained many specimens of the new cestode, *Raillietina leipoae,* while from the latter bird a few immature Davaineids, probably belonging to another species of *Raillietina* were collected.

We desire to thank Messrs. Ellis and Lawson for obtaining the birds for us; and to express our indebtedness to the Commonwealth Research Grant to the University of Adelaide. Type material has been deposited in the South Australian Museum.

Raillietina (Raillietina) leipoae n.sp.

The worms are very small, most of them between 3 and 6 mm. in length, none exceeding the latter. The strobila consists of relatively few segments (23–33). All specimens are mature and possess at least one gravid proglottis. The latter probably became detached readily since there is usually only one attached to the strobila, although the last five or six segments contain developing eggs, and numerous single gravid proglottids were found free in the intestinal lumen. The maximum breadth of the strobilae was one to three millimetres, most being strongly contracted.

The scolex may reach ·65 mm. in length but when contracted measures ·4–·5 by ·3–·45 mm. The hemispherical rostellum measures ·24–·28 mm. in diameter, and at its base has 133–154 hammer-shaped hooks, each with a long ventral and a short dorsal root, and a short spine. These hooks are arranged in two alternating series, those of the inner being 52μ, and of the outer 39μ in total length. Their difference in form is indicated in fig. 3, 4. "Total length" is the distance between two parallel lines drawn from the ends of the hook (Stevenson, 1904). Behind the rostellum are 20–40 rows of very small spines, giving the

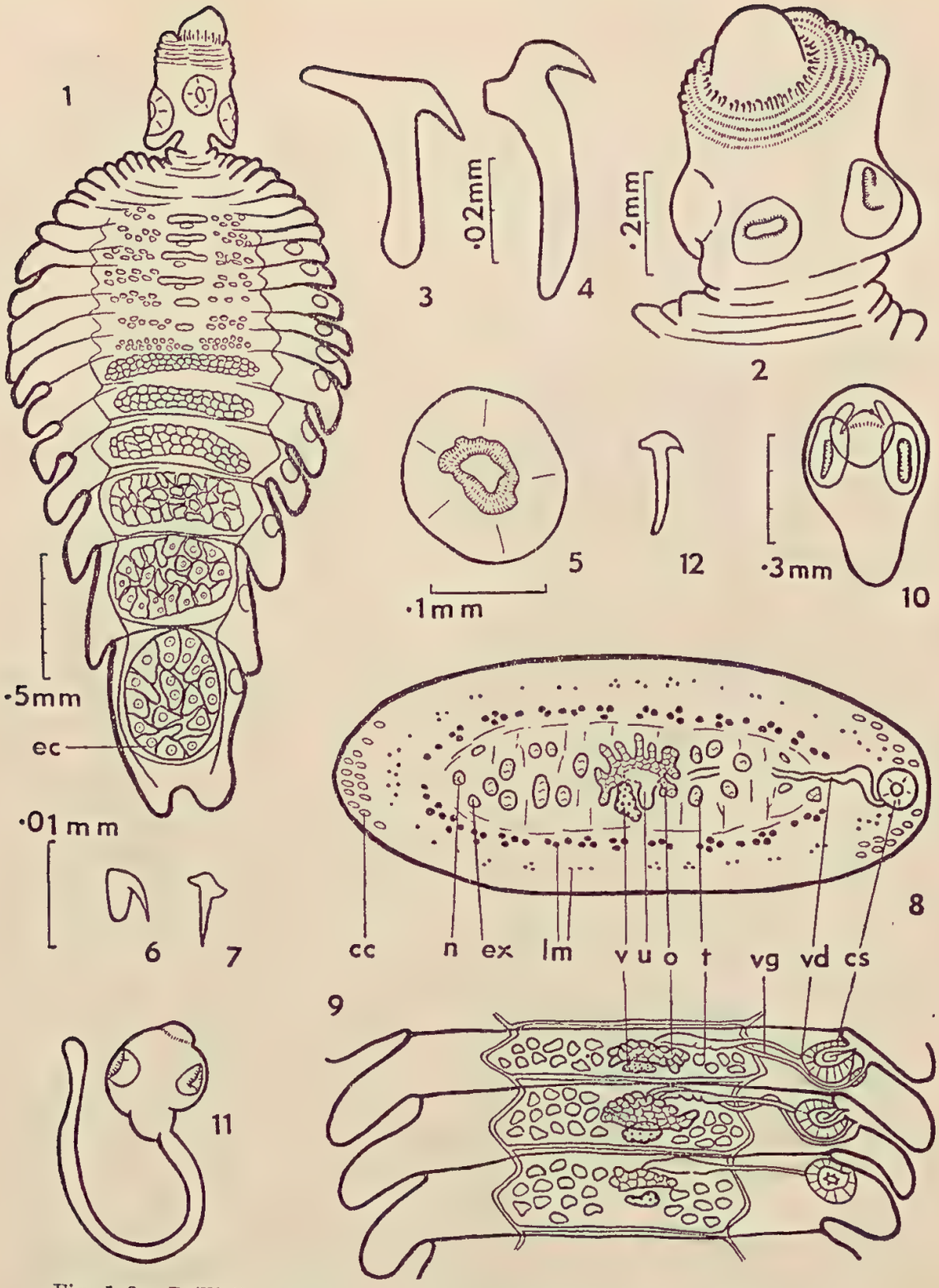


Fig. 1–9. *Raillietina leipoae.* 1. strobila; 2. scolex; 3–4. rostellar hooks; 5. sucker; 6. post-rostellar spine; 7. spine from sucker; 8. T.S. mature segment; 9. mature segments, dorsal view. Fig. 10–12. *Raillietina* sp. immature. 10, 11. young forms; 12. rostellar hook.

cc. calcareous corpuscle; cs. cirrus sac; ec. egg capsule; ex. excretory canal; lm. longitudinal musculature; n. longitudinal nerve; o. ovary; t. testis; u. uterus; v. vitellarium; vd. vas deferens; vg. vagina.

anterior end of the scolex a ringed appearance. These spines resemble rose thorns in form and are 6μ long, with a broadened base and a short recurved spine (fig. 6).

The suckers are round (·16 mm. diameter) or elliptical (·2 by ·15 mm.) and bear on the rim about 15 rows of very small, closely set spines each 6–8μ in total length, with short dorsal and ventral roots and a long spine (fig. 5, 7).

In most worms a neck was not observed, perhaps due to the state of contraction, but occasionally the scolex was seen to overhang a very short neck, about 65μ long. The segments are at first very short and narrow, but soon increase markedly in breadth. All proglottids except one or two terminals are broader than long. As the uterine capsules develop, segments become narrower and longer until the last one or two may be squarish or even longer than broad. The mature strobila thus becomes somewhat elliptical. The genital pores are unilateral and open on the anterior border of the laterally projecting lobe of the segments, close to the posterior margin of the preceding proglottid. The genital ducts pass between the two longitudinal excretory canals, and dorsally to the nerve cord.

Calcareous corpuscles, 5–10μ in diameter, are scattered in the cortex, more particularly in that of the lateral projecting region, but they occur also in the posterior part of the scolex where they may be seen around the suckers. The inner longitudinal musculature is composed of bundles of larger fibres while the outer consists of smaller, more scattered fibres which are more abundant in the lateral regions of the segment. The circular musculature is rather weakly developed. The lateral nerve cords lie just laterally from the excretory ducts. Of the latter, the ventral may measure up to 8·5μ in internal diameter and communicate by wide transverse canals, while the dorsal canals are very narrow, 1–5μ in diameter, with thick walls.

There are 22–33 testes, 14–21 of them on the aporal side, 8–12 on the poral side of the female organs. The vas deferens becomes coiled as it passes laterally from the median line of the segment. The small pyriform cirrus sac, ·1–·13 by ·06–·07 mm., does not extend inwards as far as the longitudinal nerve cord, much of it lying in the overhanging portion of the proglottis. The unarmed cirrus lies somewhat coiled, when at rest, within its sac and is supplied with gland cells. The genital atrium is shallow.

The female glands lie somewhat nearer the poral side of the segment. The strongly lobed ovary is ·167–·2 mm. in maximum breadth. The yolk gland lies behind it but is displaced slightly towards the aporal side; it is weakly lobed and measures ·085–·12 mm. in diameter. The vagina travels beside the vas deferens in the anterior part of the segment. Near the genital pore it has a muscular coat and numerous gland cells. The female pore lies immediately

behind the male aperture. The uterus which can be seen in relatively few segments, lies ventrally behind the ovary, and between the latter and the yolk gland. Its branches extend dorsally and ventrally in the medulla. Its walls soon disappear and the eggs come to lie singly and evenly distributed throughout the medulla, but these eggs become collected later into parenchymatous capsules. The fully gravid segment contains 20–30 such uterine capsules, closely packed and of irregular form, but they do not extend beyond the excretory canals, though they may displace the latter almost to the extreme edge of the segment. These capsules measure about ·16–·2 mm. by ·18–·23 mm., and each contains 21–26 eggs which measure about 11–13μ by 13–14μ, with hooklets 5–6μ long.

R. (*R.*) *leipoae* differs from all known species of the subgenus from Galliform birds in its small size, large rostellar hooks, the series of post-rostellar spines, and the number and contents of the uterine capsules. The only other representative of the subgenus from this order of birds, possessing relatively large rostellar hooks is *R.* (*R.*) *williamsi* Fuhrmann (1932, 47), syn. *Davainea fuhrmanni* Williams (1931, 17), whose hooks measure 37–39μ and 33–34μ respectively, as against 52 and 39μ for *R.* (*R.*) *leipoae*. In *R.* (*R.*) *permista* Southwell and Lake (1939, 76) which has only 36 hooks, minute spinules, visible only under oil immersion, are said to be present on the cuticle surrounding the rostellum whereas in *R. leipoae* these hooks are distinctly visible under high power magnification. Other species of the subgenus possessing post-rostellar spines are *R. torquata* Meggitt (1924, 307) with 150 hooklets, 7 and 7·5μ long, the host being a Burmese pigeon; *R. frontina* Duj. 1845, with 180 hooklets, 7–8μ long; and *R. comitata* Ransom (1909, 141), with 80 hooklets, 11–13μ long, the two latter cestodes occurring in Piciform birds.

R. (*R.*) *leipoae* differs from other members of the subgenus from Galliform hosts in the number of egg capsules (up to 26, each with 24–30 eggs). In other species there may be 50–100 capsules, each with rarely more than 15 and usually less than 10 eggs.

RAILLIETINA sp.

Fig. 10–12.

Three very young Davaineid worms, probably belonging to a *Raillietina*, were found in the intestine of *Leipoa ocellata* from Strathalbyn. One is still in the cysticercoid stage (fig. 10) and measures ·52 mm. by ·36 mm.; in another the hind part is ruptured, the specimen measuring ·62 by ·38 mm. The third (fig. 11) possesses a long, narrow appendage which may be a developing strobila or the remains of a caudal appendage; its scolex is ·46 mm. long by ·38 mm.

wide, and the total length is 2·1 mm. The hemispherical rostellum in the three worms is ·15–·16 mm. in diameter, and has about 400 very small hooks, 11–12μ in total length, arranged in two very closely approximated rows. Each hook is hammer-shaped with a long ventral and short dorsal root and a short spine (fig. 12). Each sucker measures ·13–·17 by ·11–·13 mm. and bears on its rim several rows of minute spines, 6–7μ in total length, each with short dorsal and ventral roots and a long spine. The worms are referred provisionally to *Raillietina* because of the double crown of numerous small hammer-shaped hooks and its armed suckers.

LITERATURE.

Fuhrmann, O. (1932) : *Les Ténias des oiseaux. Mem. Univ. Neuchatel,* xviii, 383 pp.

Meggitt, F. J. (1924) : *Parasitol.,* xix, pp. 303–312.

Ransom, B. H. (1909) : *U.S. Nat. Mus. Bull.,* 69, 141 pp.

Southwell, T. and Lake, F. (1939) : *Ann. Trop. Med. Parasit.,* xxxiii, pp. 107–123.

Stevenson, E. C. (1904) : *Stud. Zool. Lab. Univ., Nebraska,* iv, pp. 191–210.

Williams, O. L. (1931) : *Jour. Parasit.* xviii, pp. 14–20.

MICROPHALLUS MINUTUS, A NEW TREMATODE FROM THE AUSTRALIAN WATER RAT

By T. HARVEY JOHNSTON, University of Adelaide.

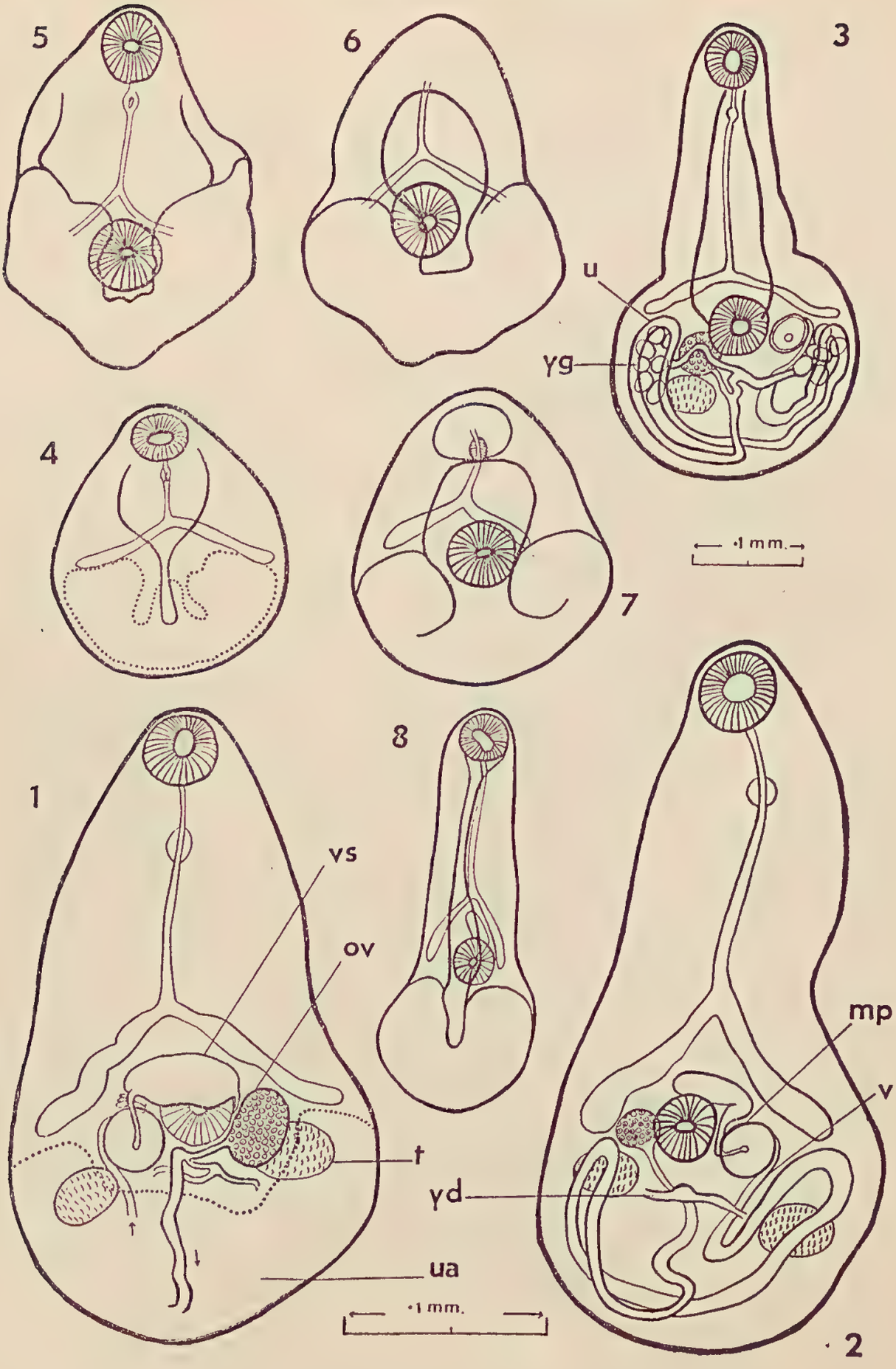
Fig. 1–8.

A very minute trematode, *Microphallus minutus* n.sp., has been found in each of the four water rats, *Hydromys chrysogaster* Geoffroy, var. *fulvolavatus* Gould, examined for parasites between May, 1938, and March, 1947. They were captured along the banks of the Murray River at Tailem Bend. The parasite was not present in one captured in the River Torrens in Adelaide, in July, 1923. The worms occurred usually in great numbers in the upper intestine.

The digestive tract of several of the rodents contained fragments of yabbies, *Cherax destructor;* one had vertebrae and lenses of small fish; and one had fragments of insects and of the mussel, *Hyridella australis.* It is of interest to note that all species of *Microphallus* and closely allied genera whose life history is known, utilize a crustacean for the metacercarial stage.

On some occasions a species of *Plagiorchis* was also present, and in one animal, that found in the Torrens, two specimens of a small diplostome, *Fibricola minor,* were also obtained. This latter trematode was described by Dubois (1936, 513; 1937, 345–8; 1938, 360–2) from material collected from the same host species taken in a suburb of Sydney, New South Wales. The known range of *F. minor* is thus very greatly extended. The two North American species of *Fibricola* whose life cycles are known, viz., *F. cratera* (Baker and Noll, 1915) Dubois 1932, and *F. texensis* Chandler 1942, have been shown to pass through the diplostomulum stage in tadpoles by Cuckler (1940, 32) and Chandler (1942, 156–167) respectively. An account of the anatomy and life cycle of the *Plagiorchis* sp. from *Hydromys* will be published separately.

Microphallus minutus varies considerably in form and dimensions according to the degree of ventral infolding of the lateral edges, and sometimes the anterior and posterior regions of the body as well. The form may thus be pyriform, or resemble a drumstick, or be almost circular in outline. In all cases the posterior third of the worm is considerably widened and it is here that the numerous eggs are located. Occasionally the infoldings along the anterior two-thirds of the body may meet or may even overlap in places, such conditions occurring when a marked drumstick form has been assumed. The largest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specimens observed measured ·41 mm. long by ·22 mm. in maximum breadth, ·35 by ·17 mm., and ·31 mm. by ·19 mm., and did not exhibit any infolding of the body margins. The third mentioned had not yet become ovigerous, though a small structure was present in the ootype and resembled the abnormal eggs containing only vitelline material, mentioned by Cable and Hunninen (1940, 143, pl. iii, fig. 13) as having been seen in *Spelotrema nicolli*. The first worm contained only sixteen eggs and was probably young, while the second contained very abundant eggs. Other worms, all of them egg-bearing, varied in dimensions, the breadth mentioned being the maximum: ·37 mm. by ·14 mm., a drumstick form with a narrow elongate anterior region; ·18 mm. by ·12 mm., with the posterior and postero-lateral regions strongly infolded; ·25 mm. by ·21 mm., an almost round form; ·14 mm. by ·13 mm. and ·187 mm. by ·187 mm., both rounded worms with the anterior, postero-lateral and posterior regions strongly infolded. A young form with narrow anterior and widened posterior regions and with infolded lateral margins and possessing well-developed yolk glands, but devoid of eggs, measured ·287 mm. by ·15 mm.

The anterior part of the body is covered by very minute scale-like spines arranged in quincunx pattern, rather more pronounced ventrally, where the spination extends slightly more posteriorly than on the dorsal surface. On the anterior part of the widened portion of the worm the scaling is smaller and less obvious, but is usually recognizable as far back ventrally as the level of the acetabulum.

The suckers are subequal, the ventrally-directed subcircular oral sucker measuring ·032–·045 mm. in length by ·03–·05 mm. in breadth, and the acetabulum ·03–·05 mm. in diameter. The latter may be sunken or even hidden, in the deep ventral concavity. Its centre lies about midway between the free ends of the crura. The distance of the posterior margin of the acetabulum from the front end of the worm varies to some extent with the degree of contraction of the parasite. In elongate worms the distance is about ·7 of the total body length, whereas in contracted specimens without any anterior infolding, it varies from ·8 to ·6, and in the latter the actual distance between the suckers also varies markedly.

There is a long, narrow prepharynx, ·012–·013 mm. long by ·008–·01 mm. wide, succeeded by a very small pharynx, ·01 by ·012 mm. The oesophagus is relatively very long in relaxed parasites and may be as long as, longer than, or somewhat shorter than, the caeca in such worms. In strongly contracted

Fig. 1–8. *Microphallus minutus*. 1. dorsal view; 2. ventral view; 3. ventral, sides infolded; 4–7. various specimens with infolded sides and ends; 8. "drumstick" form. Fig. 1, 2, 5, 6, 7 drawn to scale beside 1 and 2; fig. 3, 4, 8 to scale below 3.

ac. acetabulum; mp. male papilla; ov. ovary; t. testis; u. uterus; ua. uterine area, anterior limit shown by dotted lines; v. vagina; vs. vesicula seminalis; yd. yolk duct; yg. yolk gland.

specimens it may be much shorter than the caeca. The caeca are slightly irregular in outline and are 2–3 times as wide as the oesophagus. They diverge widely to terminate just in front of the uterine region. In a few worms the V-shaped excretory bladder with very wide short limbs was recognizable.

The two testes are transversely elliptical, ·027 by ·037 mm., and symmetrically placed in the widest part of the worm, just behind the level of the acetabulum. The right testis lies just behind the ovary and may be in contact with it. The seminal vesicle is a conspicuous, somewhat elliptical organ lying transversely between the crura, and in front of and partly above, the anterior portion of the acetabulum. It measures about ·05 by ·07 mm. in larger worms. The end adjacent to the ovary receives the vas deferens which enters it at almost a right angle, its position being between the ovary and acetabulum. The vesicle becomes suddenly narrowed at its left extremity to become the slender ejaculatory duct which travels posteriorly close to the acetabulum and is surrounded by small prostate glands. The duct then passes directly ventrally through the relatively large circular (in surface view) muscular male copulatory sac or penis which occupies most of the genital atrium. This sac has a diameter of about ·025–·03 mm., i.e. slightly less than that of the acetabulum. The sac lies on the left of the midline at about the same level as, or slightly behind, the midregion of the ventral sucker.

The ovary is rounded, about 0·27 mm. in diameter, and situated laterally in front of the right testis, with its anterior region lying between the acetabulum and the termination of the right caecum. It may overlie partly the testis. The oviduct travels inwards, downwards and posteriorly to receive the yolk duct and then enter the ootype which is median behind the acetabulum. A short, narrow sinuous Laurer's canal was seen in one worm, but a receptaculum seminis was not observed with certainty. Surrounding the ootype are the shell glands. The uterus travels back in a wavy course more or less in the median line, towards the posterior end of the worm, then curves to the right, continuing approximately parallel with the margin of the parasite, and extending forwards below the yolk glands and right testis. It then becomes sharply bent on itself just behind the ovary to form another sinuous loop just in front of the first loop and passes across to the left side, continuing forwards to lie below the yolk glands and left testis. It then becomes folded again, this portion travels inwardly and posteriorly to become bent once more near the median line. It now travels forwards in a more dorsal position between the acetabulum and the male sac, terminating as the vagina at the female pore in the genital atrium, probably just in front of the male sac. In most specimens the uterus is so swollen with eggs that its course is not recognizable and the posterior region of the parasites has become considerably thickened. In such cases the uterine region takes the

form of a U with very wide short limbs, which in some worms converge and almost meet at the tips, and with the swollen terminal part of the organ extending from the base of the U forwards towards the acetabulum before becoming narrowed to form the vagina. Eggs are very numerous and uniform, measuring 19–20μ by 10·5–11·5μ.

There are six or seven rounded yolk follicles on each side, arranged close together and seen only in younger worms. They form a compact vitelline field on each side just behind, or partly below, the testes and above the uterus. From each group a yolk duct travels inwardly in a slightly sinuous course, the two ducts uniting behind the acetabulum to form a common vitelline duct or yolk reservoir which enters the ootype close to the shell gland.

Baer (1943, 69) placed the following Microphalline genera under the synonymy of *Microphallus*: *Monocaecum* Stafford, from a Canadian urodele; and *Spelophallus* Jägersk. and *Spelotrema* Jägersk. from shore birds. *Microphallus* was known previously only from fish. All of these are similar in anatomy in spite of the diversity of hosts. We have accordingly described our species as *Microphallus minutus* rather than *Spelotrema minutum.*

Baer (1943, 64) described *M. gracilis* from a small aquatic insectivore, the shrew-mouse or water shrew, *Neomys fodiens,* from Swiss streams. Our species differs from it in being much smaller; in the relatively longer caeca; in the position and extent of the vitelline follicles; the much larger relative size of the male papilla; the relative sizes of the two suckers; and in its smaller eggs.

Ochi (1928; 1940, 289) described a Japanese species, *M. minus* (i.e. *minor*), whose cercariae became encysted in the muscles of shrimps (*Palaemon*), the adult stage being obtained experimentally from mice, dogs, cat and man, the natural hosts being the dog and the river rat. Ochi's original account (in Japanese) is not available and Baer did not place the species in his key (1943, 70–1).

Africa and Garcia (1935, 257) reported that *Heterophyes brevicaeca* occurred in man in the Philippines. The species was re-examined by Tubangui and Africa (1938, 117) and transferred by them to *Spelotrema,* Baer (1943, 70) subsequently placing it under *Microphallus. M. brevicaeca* resembles our species but it is considerably larger, the yolk glands are much more extensive, the ovary is slightly larger than the testes, the prepharynx is shorter, and scales occur in part of the region behind the acetabulum. The natural hosts are man and a tern, *Sterna albifrons.*

The only other member of the Microphallinae known from Australia is *Levinseniella howensis,* described by S. J. Johnston (1917, 220–23) from material which I collected in 1910 from *Charadrius dominicus* on Lord Howe Island. *M. minutus* appears to be smallest adult digenetic trematode as yet known from Australia.

Considerable confusion has occurred concerning the genera, *Microphallus*, *Spelotrema* and *Levinseniella*, attention having been drawn to that affecting the two latter by Rankin (1939, 431–2) and by Cable and Hunninen (1940, 153–4). *Levinsenia* was erected by Stossich in 1892 to include four species of *Distomum—opacum, brachysomum, pygmaeum* and *macrophallos*. The second of these was selected by Lühe in 1889 as type of the genus, but Jägerskiöld soon afterwards (1910) designated *Distomum pygmaeum* as type. Ward, who had described *D. opacum* in 1894 from a North American fish, *Amia calva*, gave a further account in 1901 and erected *Microphallus* to receive it and referred to *Levinsenia* as a preoccupied name. Stiles and Hassall (1901) replaced the latter by *Levinseniella*, and a few months later Jägerskiöld (1901) erected *Spelotrema* with *Dist. pygmaeum* as type, and subsequently (1907) founded a new genus on his *Sp. primus*. The characters of *Levinseniella* must be based on its first designated type, i.e. *D. brachysomum*, and since *Spelotrema* was a subsequent renaming of *Levinsenia* Stossich, it must take for its type *brachysomum* instead of *pygmaeum* which has a different, but related structure of the terminal genital ducts, and is admittedly distinct generically from the species now allocated to *Levinseniella* by Rankin (1939) and other authors. Cable and Hunninen (1940, 154) stated "His (i.e. Jägerskiöld's) later (1907) conception of two distinct genera is valid, however, and must be accepted, although he should not have retained for them names which he had regarded previously as synonyms. To suppress *Spelotrema* as a synonym of *Levinseniella*, and propose a new generic name for the species at present allocated to the genus *Spelotrema*, would probably increase rather than diminish the present confusion. For this reason, the writers are inclined to let the matter stand." I do not agree with this conclusion since *Spelotrema* was a renaming of *Levinsenia* and is therefore a synonym of *Levinseniella* which has some months' priority. The species now included under *Spelotrema* by Rankin (1940), Dawes (1946) and other authors must be accommodated elsewhere. Baer (1943, 70) has shown that *Spelotrema* of authors is a synonym of *Microphallus* since the anatomy of the two groups of species is essentially similar. The difference between *Spelotrema* and *Spelophallus* is said to lie in the position of the vaginal opening into the atrium in relation to the male papilla, but Baer (p. 70) regards the two as synonymous and has added Stafford's *Monocaecum* (1903) also.

Microphallus is based on *M. opacus* Ward from *Amia*. Osborn (1919, 123) described *M. ovatus* from another North American fish, *Micropterus*, the species differing from Ward's in possessing very rudimentary caeca and in the relative sizes of the two suckers. Wright (1912, 167) redescribed *M. opacus*, and recently Strandine (1943) examined a very extensive series of Microphallids from the two fish host species and reported a very wide degree of variation in

regard to these features. Strandine showed that in *M. opacus* the caeca might be small as described by Ward, or very small and equally developed, very small and unequal, or only one (either right or left) might be present, or they might be represented merely by a small bilobed sac. He regarded *M. ovatus* as being only a variety of *M. opacus.* Stafford's *Monocaecum baryurum* (1903, 822) from a Canadian urodele suggests a similar degeneration of the caeca which have become represented by a small median sac.

Attempts have been made by us to elucidate the life history of *M. minutus,* but so far without success. Two excellent studies of the life cycles of Microphalline trematodes have been published by American investigators, Cable and Hunninen (1938, 1940) and Rankin (1939a, 1940). Cable and Hunninen dealt with *Spelotrema nicolli* whose cercaria belongs to the *Ubiquita* group and develops in sporocysts in a very small marine gastropod, *Bittium,* the metacercaria occurring in crabs, and the adult (experimentally) in a gull, *Larus argentatus.* They also described an allied cercaria, *C. nassicola,* from another marine gastropod, *Nassa* (1938, 1940). This latter cercaria was shown by Rankin (1940) to be the larva of a Microphallid which he had previously (1939) described as *Cornucopula sippiwissettensis.* Rankin reported that the metacercaria occurred in an amphipod, *Talorchestia,* and the adult (experimentally) in *Larus argentatus.* As Yamaguti had just previously (1939) erected *Gynaecotyla* to receive Microphallids having a similar anatomy, Rankin (1940) recorded his observations on the life history under *Gynaecotyla nassicola.* It should be noted that Baer (1943, 66, 7) has used the name *Gynaecocotyla.* As mentioned above, the known Microphalline cercariae belong to the *Ubiquita* group of monostome Xiphidiocercariae, and the metacercaria occurs in crustaceans. The cyst is spherical or slightly elongate, and thickwalled, and contains the metacercaria whose anterior and posterior regions are folded ventrally, this stage possessing well-developed genitalia (except the uterus) like those of the adult and approaching the adult in size (Rankin 1940, fig. 6; Cable and Hunninen 1940, pl. i, fig. 5–6, pl. ii., fig. 7–8). The adult stage was reached in a shore bird within 12 hours to two days after feeding on infected crustaceans.

It has been noted that, in our species, worms in which egg production had not commenced, were not necessarily smaller than those in which it had; and that egg-bearing specimens were seen in which the body was folded to form a more or less spherical animal, ·14 to ·18 mm. in diameter. In *M. nicolli* the diameter of the cyst was ·05–·5 mm. and the adult ·51–·58 mm. long; in *G. nassicola* the cyst was ·26–·29 mm. in diameter with its wall ·015 mm. thick, and the adults were ·3–·36 mm. long. We suggest that the cyst stage of *M. minutus* probably occurs in the yabbie, *Cherax destructor,* and measures ·2–·3 mm. (perhaps less) in diameter. The only other crustaceans in the Murray River which may be

considered as hosts for the metacercaria are the shrimp (*Paratya australiense*) and prawn (*Palaemon australis*), since the only species of amphipod (*Chiltonia subtenuis*) and crab (*Halicarcinus lacustris*) which occur there are probably too small (and the latter also too uncommon) to serve as food for such a large animal as *Hydromys*.

Acknowledgment is made gratefully to Messrs. G. G. and Bryce Jaensch for assistance in obtaining the water rats from the Murray at Tailem Bend, and to the Commonwealth Research Grant to the University of Adelaide for travelling expenses.

Type material has been deposited in the South Australian Museum.

LITERATURE.

Africa, C.M. and Garcia, E. Y. (1935) : *Philippine Jour. Sci.*, lvii, pp. 253–267.

Baer, J. G. (1943) : *Bull. Soc. Neuchat. Sci. Nat.*, lxviii, pp. 33–84.

Cable, R. M. and Hunninen, A. V. (1938) : *Jour. Parasit.*, xxiv, Suppl. Abstr., pp. 29–30.

Cable, R. M. and Hunninen, A. V. (1940) : *Biol. Bull.*, lxxviii, pp. 136–157.

Chandler, A. C. (1942) : *Tr. Amer. Micr. Soc.*, lxi, pp. 156–167.

Cuckler, A. C. (1940) : *Jour. Parasit.*, xxvi, Suppl. 32.

Dawes, B. (1946) : The trematoda, with special reference to British and other European forms. Cambridge.

Dubois, G. (1936) : *Rev. Suisse de Zool*, (xliii), pp. 507–515.

Dubois, G. (1937) : *Ann Parasitol*, xv, pp. 333–353.

Dubois, G. (1938) : Monogr. Strigeida (Trematoda). *Mem. Soc. Neuchat. Sci. Nat.*, vi, 535 pp.

Johnston, S. J. (1917) : *Jour. Proc. Roy. Soc., N.S.W.*, 1 (1916), pp. 187–261.

Ochi, S. J. (1928) : Nihon Byori Zasshi, 18. Abstract in *Jap. Jour. Med. Sci.*, 6, 1, 1940, p. 289.

Osborn, H. L. (1919) : *Jour. Parasit.*, v, pp. 123–7.

Rankin, J. S. (1919) : *Tr. Amer. Micr. Soc.*, lviii, pp. 431–47.

Rankin, J. S. (1939a) : *Jour. Parasit.*, xxv, Suppl. 12.

Rankin, J. S. (1940) : *Biol. Bull.*, lxxix, pp. 439–51.

Stafford, J. (1903) : *Centr. Bakt. Orig.*, xxxiv, pp. 822–30.

Strandine, E. J. (1942) : *Tr. Amer. Micr. Soc.*, lxii, pp. 293–300.

Tubangui, M.A. and Africa, C. M. (1938) : *Philippine Jour. Sci.*, lxvii, pp. 117–127.

Ward, H. B. (1901) : *Tr. Amer. Micr. Soc.*, xxii, pp. 175–187.

Wright, S. (1912) : *Tr. Amer. Micr. Soc.*, xxxi, pp. 167–176.

Some NEW RECORDS of NEMATODES from AUSTRALIAN SNAKES

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Fig. 1–8.

The parasites recorded below are part of a collection made over a period of years by the senior author, assisted by colleagues in various parts of Australia. To these collaborators (Dr. J. B. Cleland; Dr. O. W. Tiegs; Messrs. G. G., and F. Jaensch; the late Dr. T. L. Bancroft) we are most grateful. Types of new species have been deposited in the South Australian Museum. The following is a list of the parasites examined, arranged under their hosts:

Python spilotes Lacep. *Physaloptera confusa* J. and M. (Helensburg, New South Wales).

Python spilotes var. *variegatus* Gray. *Polydelphis anoura* (Duj.) (Taronga Park, Sydney, and Gosford, New South Wales; Sandgate, Brisbane, Queensland); *Ophidascaris filaria* (Duj.) (West Burleigh, South Queensland).

Python amethystinus Schn. *Polydelphis anoura* (Duj.) (Port Curtis, Queensland).

Python reticulatus Schn. *Polydelphis anoura* (Duj.); *Hastospiculum* sp. (Sydney Zoological Gardens).

Acrochordus javanicus Homstedt. *Tanqua ophidis* n.sp. (Leichhardt River, North-western Queensland).

Acanthophis antarctica Shaw. *Physaloptera confusa* J. and M. (Sydney).

Denisonia superba Gunth. *Physaloptera confusa* J. and M. (Tailem Bend, South Australia).

Demansia textilis D. and B. *Physaloptera confusa* J. and M. (Tailem Bend, South Australia).

Demansia psammophis Schl. *Ophidascaris pyrrhus* J. and M. (Victoria; Sydney); *Physaloptera confusa* J. and M. (Victoria); *Physaloptera demansiae* n.sp. (Sydney).

Demansia reticulata Gray. Perhaps *D. psammophis* var. *reticulata*. *Physaloptera confusa* J. and M. (North Western Australia).

Natrix mairii Gray (=*Tropidonotus picturatus* Schl. of some Aust. authors). *Tanqua ophidis* n.sp. (North Queensland).

Pseudechis porphyriacus Shaw. *Physaloptera confusa* J. and M. (Dalby, Queensland; Sydney).

Notechis scutatus Peters. *Ophidascaris pyrrhus* J. and M. (Victoria; Tailem Bend, South Australia).

Furina occipitalis D. and B. *Kalicephalus* sp. (Burnett River, Queensland).

Hydrus platurus Linn. *Paraheterotyphlum australe* ng., n.sp. (Little Bay, Sydney).

Also the lizard, *Varanus varius* Shaw. *Tanqua tiara* (Linst.) (New South Wales).

KALICEPHALUS sp.

(Fig. 1.)

From the ring snake *Furina occipitalis*, collected on the Burnett River, Queensland, by the late Dr. T. L. Bancroft.

Females only present, 5–8 mm. in length. Eight cephalic papillae around mouth. Buccal capsule massive around base, laterally compressed; its internal diameter dorsoventrally is ·043 mm., from side to side at its widest part ·025 mm., and its length ·045 mm. The course of the duct of the dorsal oesophageal gland is shown in Fig. 1.

The oesophagus is ·28 mm. long in a worm 5 mm. long, the nerve ring surrounding it at ·17 mm. from the anterior end of the parasite. The excretory pore lies at the same level as the nerve ring. The vulva is situated just posterior to the midlength of the worm.

PARAHETEROTYPHLUM AUSTRALE n.g., n.sp.

(Fig. 2–3.)

From a sea snake, *Hydrus platurus*, washed ashore at Little Bay, Sydney. Material consists of two females and one male worm, the former 10 and 10·5 mm. long, the latter 6·7 mm. long. The head bears three lips, longer than broad; the dorsal with two papillae, the ventrals each with one papilla; interlabia are absent. No teeth were seen on the lips. The oesophagus, 7·6 mm. (female) and 5·6 mm. (male) in length, is rather sac-like and terminates in an ill-defined ventriculus, from which extends a long thin appendix, 3·6 mm. in length in

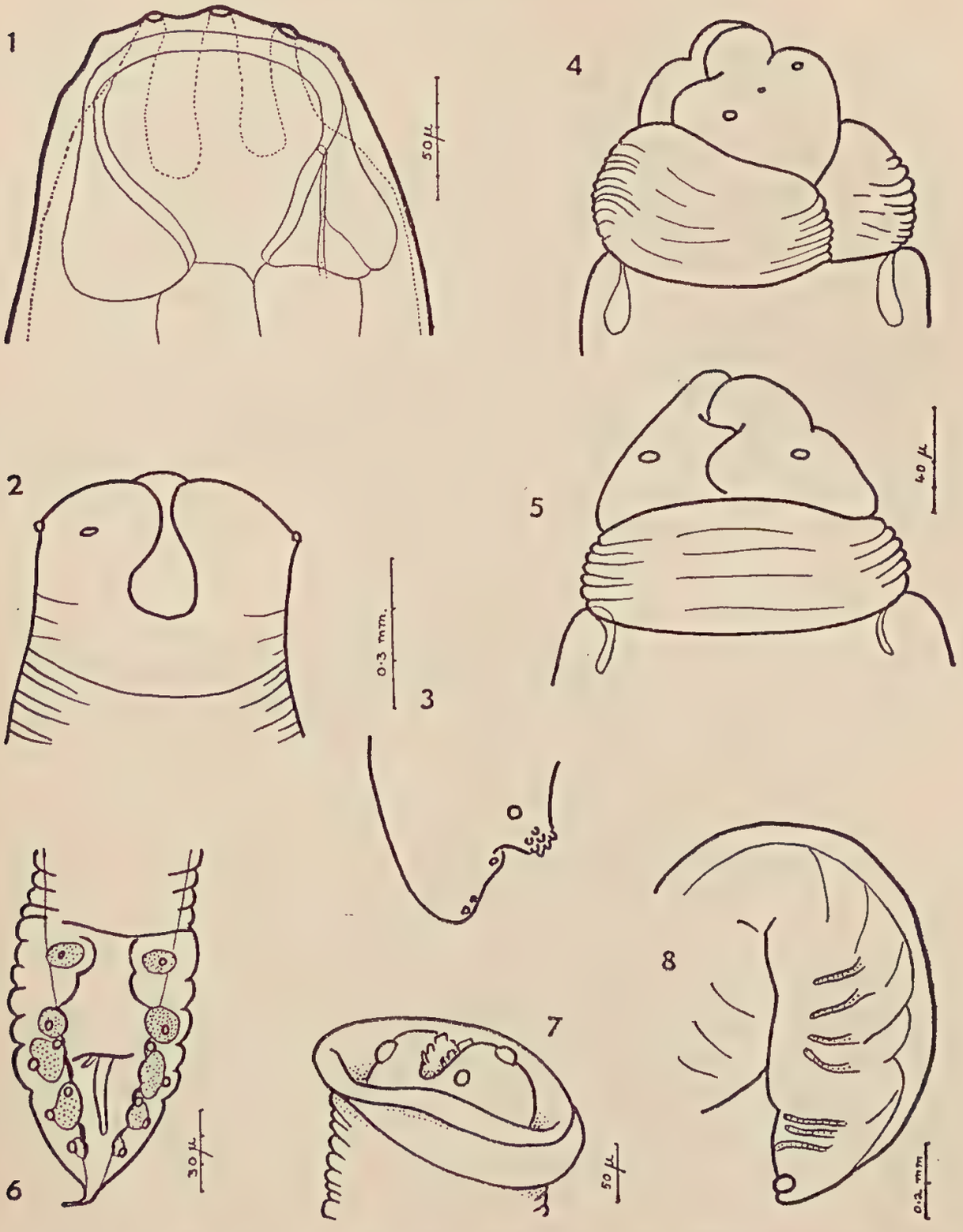

Fig. 1. *Kalicephalus* sp. lateral view of head. Fig. 2–3. *Paraheterotyphlum australe*, 2. head; 3. posterior end of male. Fig. 4–6. *Tanqua ophidis*, 4. and 5. subdorsal and lateral views of head; 6. male tail. Fig. 7–8. *Physaloptera demansiae*, 7. head; 8. male tail. Fig. 2 and 3 to same scale; fig. 4 and 5 to same scale.

female, 2·8 mm. in male. There is a short intestinal caecum, ·88 mm. long in the female, ·64 mm. in the male.

In the male are about 43 pairs of preanal papillae, as well as a median group of about six to seven pairs just anterior to the arms. There are three pairs of postanal papillae on the short blunt tail. The spicules are ·88 mm. long.

The vulva lies in the second quarter of the body length (6·1 mm. from the head). The eggs are subspherical, 45 mm. in diameter, with a smooth thick shell.

Generic diagnosis: *Stomachinae*: interlabia present, without denticles on lips; spherical ventriculus, oesophageal appendix and intestinal caecum present. Spicules more or less equal. Vulva in first third of body length.

These characters of the head and alimentary canal occur together only in one genus of Stomachinae, namely, *Heterotyphlum* Spaul 1927, described from a deep sea angler fish from Iceland. The present specimens are distinguishable from that genus by the possession of equal spicules.

OPHIDASCARIS PYRRHUS J. and M.

This species is now recorded from the tiger snake, *Notechis scutatus*, collected by the late Dr. Dombrian in Victoria; and from Tailem Bend, South Australia (G. G., and F. Jaensch); and also from the grey or whip snake, *Demansia psammophis* from Sydney and from Victoria.

OPHIDASCARIS FILARIA Duj.

A new host record for this species is the carpet snake, *Python variegatus*, from which it was taken at West Burleigh, Queensland.

POLYDELPHIS ANOURA Duj.

This species is now recorded from *Python reticulatus* (Taronga Park, Sydney), *Python variegatus* (Taronga Park, Sydney, and Gosford, New South Wales; and Sandgate, South Queensland); and from *Python amethystinus* (Port Curtis, Queensland).

TANQUA OPHIDIS n.sp.

(Fig. 4–6.)

From a fresh water snake, *Natrix mairii* Gray (type host), collected in the north-eastern coastal region of Queensland by Dr. O. Tiegs; and from *Acrochordus javanicus*, Leichhardt River, North Queensland.

Males up to 27 mm., females to 30 mm. in length. Oesophagus of female 4 mm., of male 3·4 mm. long; and cervical sacs ·4 mm. and ·24 mm. long respectively. The head bulb is subdivided into two dorsoventral swellings. The nerve ring is ·5 mm. from the anterior end in the male.

The vulva lies at about the commencement of the posterior quarter of the body length. The eggs are very small, about 32μ by 40μ.

The spicules are typical of the genus, stout, tapering slightly, somewhat swollen at the tip, and beset with fine stiff bristles. The arrangement of the caudal papillae in the male closely resembles that of other species in the genus, and is shown in fig. 6.

Differences between species in this genus appear to lie mainly in the characters of the anterior end. The present specimens resemble *T. anomala* (Linst.), also from *Tropidonotus* spp., and *T. diadema* Baylis, from *Helicops* sp. from Brazil, in having but two divisions of the head bulb. The shape of the lips is more like that figured for *T. diadema,* but there is no deep collar as in that species. In addition, the position of the vulva is more posterior than in *T. diadema.*

TANQUA TIARA Linst.

This species is now recorded from the monitor lizard, *Varanus varius* from Gosford, New South Wales. It was previously reported from *Varanus gouldii* by Parona 1898, from Australia or New Guinea.

PHYSALOPTERA DEMANSIAE n.sp.

(Fig. 7–8.)

From *Demansia psammophis,* Sydney. Both males and females present. Length of males, 12–15 mm.; females, 20–25 mm. Each lip bears on inner margin one large "blunt" median tooth, and on each side of this two smaller conical teeth. One pair of papillae is also present on each lip. No dentigerous ridge, or series of denticles, was observed. The oesophagus measures 2·4 mm. (female), its muscular anterior part being 1·7 mm. long, surrounded at about its midlength by the nerve ring. The excretory pore is 2·5 mm. behind the head.

The vulva is near the midlength of the body. The posterior third of all the males present in the collection is tightly coiled so that even by cutting the worm it is impossible to obtain a ventral view of the cloacal region. The spicules are acicular, 1·3 mm. and ·25 mm. in length. The alae are voluminous and apparently meet ventrally. They support four pairs of pedunculate adanal papillae, three pairs of pedunculate postanal papillae, and a pair of short stout papillae near the tip of the tail. This last pair is of unusual size and is sufficient to distinguish a new species.

PHYSALOPTERA CONFUSA J. and M.

This species is recorded from *Demansis textilis* (Tailem Bend, South Australia); *Demansia psammophis* (Victoria); and *Pseudechis porphyriacus* (Dalby, Queensland; and Sydney). Females probably belonging to the species were taken from *Python spilotes* var. *variegatus* (Helensburg, New South Wales); *Acanthophis antarctica* (Sydney); *Demansia reticulata* (Western Australia); and *Denisonia superba* (Tailem Bend, South Australia).

HASTOSPICULUM sp.

From *Python reticulatus*, Sydney Zoological Gardens. Single female present, its length 37·4 mm. As specific identification in this genus depends on the characters of the male, this specimen cannot be assigned to a species. The pair of very small toothlike projections about the mouth are bifid. The anterior part of the oesophagus is ·6 mm. long, surrounded near its base by the nerve ring. The vulva is very small, 2 mm. from the head end.

LITERATURE.

Baylis, H.A. and Lane, C. (1920): *Proc. Zool. Soc., 1920*, pp. 245–310.

NATIONAL MUSEUM
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AUSTRALIAN CUMACEA. No. 15[1]

The FAMILY BODOTRIIDAE (Cont.)[2]

By HERBERT M. HALE, Director, South Australian Museum.

Fig. 1–9.

This paper deals mainly with Western Australian material collected by Dr. A. G. Nicholls, and Messrs. G. P. Whitley, J. Clark, and R. Kenny; notes were previously published[1] concerning the species *Cyclaspis* known to occur off the Indian Ocean coast of Australia. Apart from fifteen members of the last-named genus, two species of the family have been described from Western Australia; eight forms are added herein, the list to date being as follows:

Bodotria maculosa Hale.
Eocuma agrion Zimmer.
Pomacuma australiae (Zimmer).
Gephyrocuma repanda Hale.
Gephyrocuma similis sp. nov.
Leptocuma serrifera Hale.
Leptocuma nichollsi sp. nov.
Vaunthompsonia nana Hale.
Glyphocuma serventyi Hale.
Glyphocuma bakeri Hale.
Sympodomma whitleyi sp. nov.

Genus Bodotria Goodsir.

Bodotria maculosa Hale.

Bodotria maculosa Hale, 1944, p. 226, fig. 1–2.

Ovigerous female (Shark Bay, G. P. Whitley, November, 1945; fig. 1, A). Caparace with upper margin, as seen from the side, almost straight but slightly irregular; it is decidedly more than one-fourth of total length of animal, about as wide as deep, and one and three-fourths times longer than deep; dorsum with a low median carina, and sides with a distinct lateral ridge as in male, below which is a less prominent longitudinal fold; the squamose patterning is shallow.

Only a small antero-lateral portion of first pedigerous somite visible; second to fifth somites together a little shorter than carapace, each with a prominent lateral carina; second somite half as long again as third, its dorsal mid-line quite strongly elevated; third to fifth somites each with a median dorsal carina, each elevated at the rear of its somite.

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1 For No. 14 see *Rec. S. Aust. Mus.*, ix, 1948, pp. 1–42, fig. 1–21.

2 See *Trans. Roy Soc., S. Aust.*, lxviii, 1944, pp. 225–285, fig. 1–38.

Pleon shorter than cephalothorax (in male it is stouter and is longer than cephalothorax); first to fifth somites with a median dorsal carina which is conspicuous on the first to fourth; these five somites also have a strong longitudinal lateral carina; telsonic somite projecting posteriorly over bases of uropods.

Peraeopods as in the South Australian males previously described, the longer carpal seta of fossorial limbs not nearly reaching to tip of dactylus.

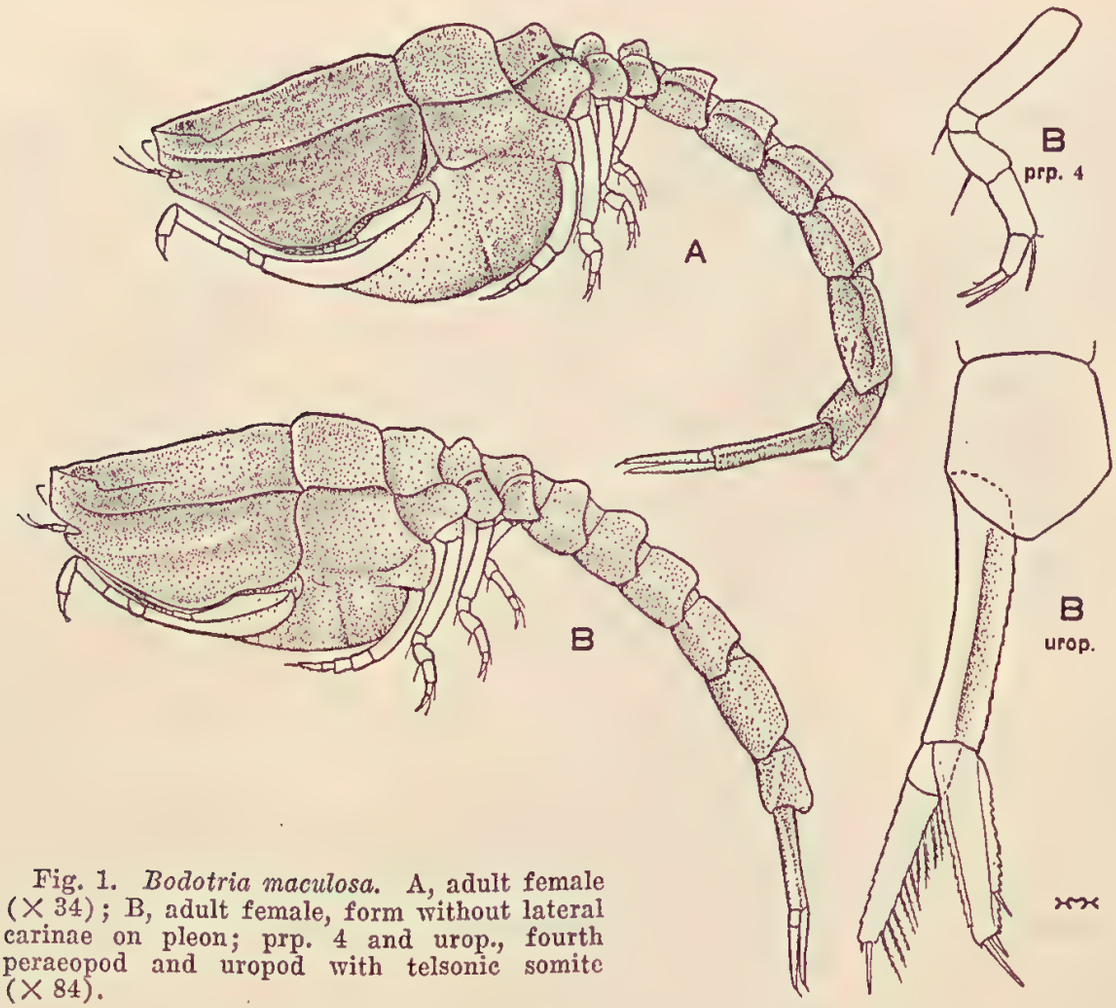

Fig. 1. *Bodotria maculosa.* A, adult female (× 34); B, adult female, form without lateral carinae on pleon; prp. 4 and urop., fourth peraeopod and uropod with telsonic somite (× 84).

Peduncle of uropod half as long again as telsonic somite and fully one-fourth as long again as exopod, which is barely longer than the endopod and bears two unequal spines at the truncate distal end, one spine being insignificant; the endopod is broad (four times as long as wide), has both edges serrate, and bears a single inner spine near the truncate distal end and two unequal terminal spines, the longer of which is less than one-third as long as the ramus and as long as longer terminal spine of exopod.

Colour as in male. Length 3·1 mm.; ova 0·21 mm. to 0·24 mm.

Ovigerous female (Houtman's Abrolhos, G. P. Whitley, December, 1945, fig. 1, B; form with no lateral carinae on pleon).

Differs from the female described above in having the median dorsal carinae of the pedigerous and pleon somites less elevated and in the total absence of lateral carinae on the last-named somites. The pitting of the carapace is faint and the lower lateral carina is represented by a low fold, margining a shallow groove. The thoracic appendages and the uropods exhibit no differences.

Length 2·9 mm.

The adult female was previously unknown; as the appendages are identical in the two forms recorded above, both are regarded as referable to *maculosa*. They resemble the female of *pumilio* Zimmer (1921, p. 119, fig. 4–7) from Formosa, but in the Australian species the uropods are distinctive. The antennal notch is narrower, and the dorsal carinae of the pedigerous somites are elevated posteriorly; in *maculosa* the exopod of the uropod is subequal in length to the endopod (including in both the longer of the terminal spines) whereas in the female of *pumilio* the exopod is one-fourth as long again as the endopod.

A large number of specimens, mostly adult males, was collected by Dr. A. G. Nicholls, and Messrs. G. P. Whitley, J. Clark and R. Kenny in and about five Western Australian localities, *viz.*, Houtman's Abrolhos, Rottnest Island, Esperance Bay, Shark Bay and North-West Cape (lat. 21.48 S. to 32.50 S.). Almost all of the males are approximately 4 mm. in length, but there is some variation in the sculpture. In the carapace both lateral and lower lateral carinae may be sharply defined; on the other hand, the shallow pits above the lower lateral carina are sometimes scarcely apparent and the ridge itself barely discernible.

A series of hauls was made at Rottnest Island (J. Clark and R. Kenny) during different periods throughout one night, using a submarine light trap. *B. maculosa* is represented in seven of the samples thus secured, mostly by males 4 mm. or so in length. In the first haul of the evening, however, an adult male and female were taken which are of much smaller size, 2·25 mm. and 2·15 mm. respectively. The little female has the margin of the dorsal crest of the second pedigerous somite, as seen from the side, straight, while the dorsal carinae of pleon somites one to five are fully as elevated as in fig. 1, A.

EOCUMA AGRION Zimmer.

Eocuma agrion Zimmer, 1914, p. 176, fig. 1–2; Hale, 1944, p. 229, fig. 3–4.

Adult males of this species have now been taken in the following localities: Queensland: Moreton Bay (I. S. R. Munro). Western Australia: Herald Bight

and Broadhurst Bight in Shark Bay, Airlie Island off Onslow, and Eaglehawk Island in Dampier Archipelago (G. P. Whitley); Careening Bay, Garden Island (A. G. Nicholls).

No specimens have been secured off the southern or northern coasts of Australia and the range as at present known is between lat. 27.0 S. and 33.50 S. on the Pacific Coast and between 20.0 S. and 32.0 S. on the Indian Ocean coast.

The mature males vary a little in size in different localities (6 mm. to 7 mm. in Shark Bay; 6·8 mm. to 7·5 mm. at Garden Island). All have the second peraeopod as figured for specimens from New South Wales (Hale, 1944, fig. 4). In the fossorial peraeopods there is usually a shorter and thinner seta, inserted just behind the long carpal seta, which reaches to the tip of the slender dactylus.

Genus ZENOCUMA Hale.

ZENOCUMA RUGOSA Hale.

Zenocuma rugosa Hale, 1944, p. 238, fig. 7, A–D, and fig. 8–9.

A female from Tasmania (middle of D'Entrecasteaux Channel, J. A. Tubb, in Scallop Dredge, April, 1945) extends the known distribution of the species; specimens previously recorded were all taken off New South Wales.

Genus POMACUMA Hale.

POMACUMA AUSTRALIAE (Zimmer).

Pomacuma australiae Hale, 1944, p. 244, fig. 12–14.

The type was taken off Cape Jaubert, Western Australia; G. P. Whitley secured the species in Shark Bay, in 1½ fathoms.

Genus GEPHYROCUMA Hale.

Two members of the genus, one described as new, occur in Western Australia; it is separated from the two species previously described as follows:

1. Exopod of third peraeopod unisegmentate .. .. .. *repanda* Hale
   Exopod of third peraeopod bisegmentate 2
2. Pleon at most barely longer than pedigerous somites together. First segment of endopod of uropod less than twice as long as second .. .. *pala* Hale
   Pleon at least half as long again as pedigerous somites together. First segment of endopod of uropod at least four times as long as second *similis* sp. nov.

GEPHYROCUMA REPANDA Hale.

Gephyrocuma repanda Hale, 1944, p. 248, fig. 15–16–17, B.

A few examples were secured at Careening Bay, Garden Island, Western Australia (A. G. Nicholls, November, 1946)—lat. 32.8 S. On the eastern coast the species is known between lat. 33.5 S. and 35.22 S. *G. repanda* was described from adult and young males and a juvenile female; adult females are now available.

Female with embryos in marsupium. Carapace barely more than two-fifths of total length of animal, less than half as long again as deep, and wider than deep, thus relatively much broader and deeper than in adult male.

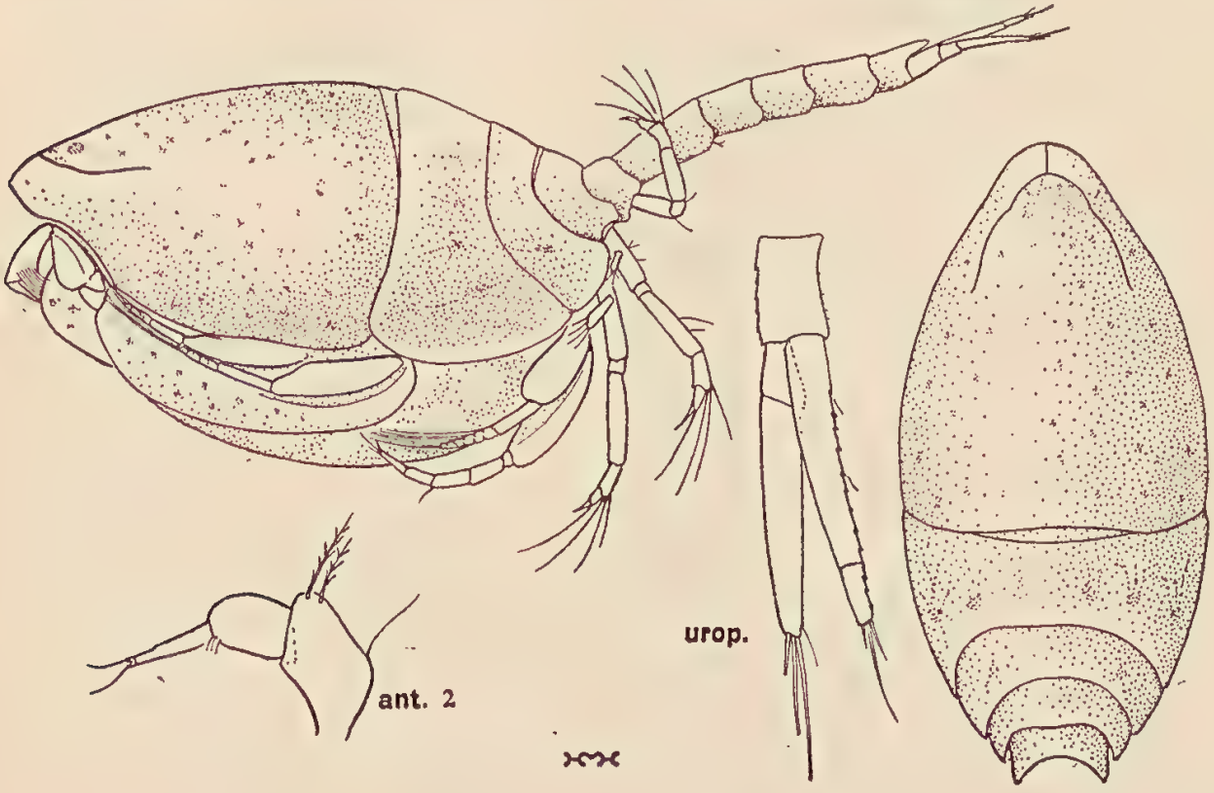

Fig. 2. *Gephyrocuma repanda.* Ovigerous female; lateral view and cephalothorax from above (× 32); ant. 2 and urop., second antenna and left uropod (× 106).

Pedigerous somites all exposed, together fully two-thirds as long as carapace; first somite short and, as in male, concealed on sides; second somite much larger than in male, its pleural length fully half that of carapace.

Pleon a little more than half length of cephalothorax and nearly half as long again as pedigerous somites together.

First antenna with flagellum two-jointed.

Second antenna distinctly three-jointed, the third segment (as in genotype)

elongate, and fully as long as second; the bases of the distal sensory appendages are stout (probably the supposed terminal jointlet in *pala*).

Thoracic appendages as in adult male and with similar exopods (see Hale, 1944, fig. 17, B, exop. prp. 3, and exop. prp. 4).

Peduncle of uropod relatively a little shorter than in male, and with no long inner setae; endopod equal in length to exopod, with its first joint more than three times as long as second; it differs from that of the male in having denticles but no spines on inner margin, but the proportions of its segments are not as in *pala*; exopod with one seta (instead of a row as in adult male) on inner edge.

Colour as described for male. Length 3·1 mm. Embryos 0·236 mm. in greatest diameter.

Loc. New South Wales: off Wata Mooli, 35 metres, and off Ulladulla, 75 metres (K. Sheard, July, 1943, and June, 1944).

The adult female of *repanda* is thus easily distinguished from that of *pala* by the single-jointed exopod of the third peraeopod, the relatively longer pleon and the proportions of the endopod of the uropod, the second segment of this ramus being more than half as long as the first in *pala* (see fig. 3).

Ovigerous female (Garden Island, Western Australia). Differs from the female described above as follows. The size is smaller, the total length only 2·4 mm. The carapace is less swollen, being deeper than wide, and like the pedigerous somites has a more distinct longitudinal median dorsal carina, which nevertheless is low and rounded. The pleon is relatively slightly shorter, only one-fifth as long again as pedigerous somites together, and not quite half as long as the cephalothorax. The uropods are much shorter in relation to the total length of the animal and on the whole present an immature appearance; the first segment of the endopod is only two and one-third times as long as second (see fig. 3). The pigmentation is reduced to a couple of chromatophores on the carapace, one on each side of mid-line of dorsum, just behind middle of length. The ova are 0·2 mm. in diameter.

Adult male (Garden Island, Western Australia). Slightly larger (3·5 mm.) than the males from the Pacific coast of Australia, but otherwise differing little. The peduncle of the uropod is relatively slightly longer, being more than half as long as the endopod. The last-named may have only two spines near the distal end of the inner margin of the first segment, and anterior to this the margin bears long plumose setae; the second segment has the usual six inner spines. The pleon, as in the New South Wales type, is more than two-thirds as long as the cephalothorax, and the proportions of the segments of the endopod of the uropod are the same.

GEPHYROCUMA SIMILIS sp. nov.

Ovigerous female. General form as in the other two members of the genus. Carapace deeper than wide, fully one-third as long as total length of animal, and with a low, median rounded dorsal carina.

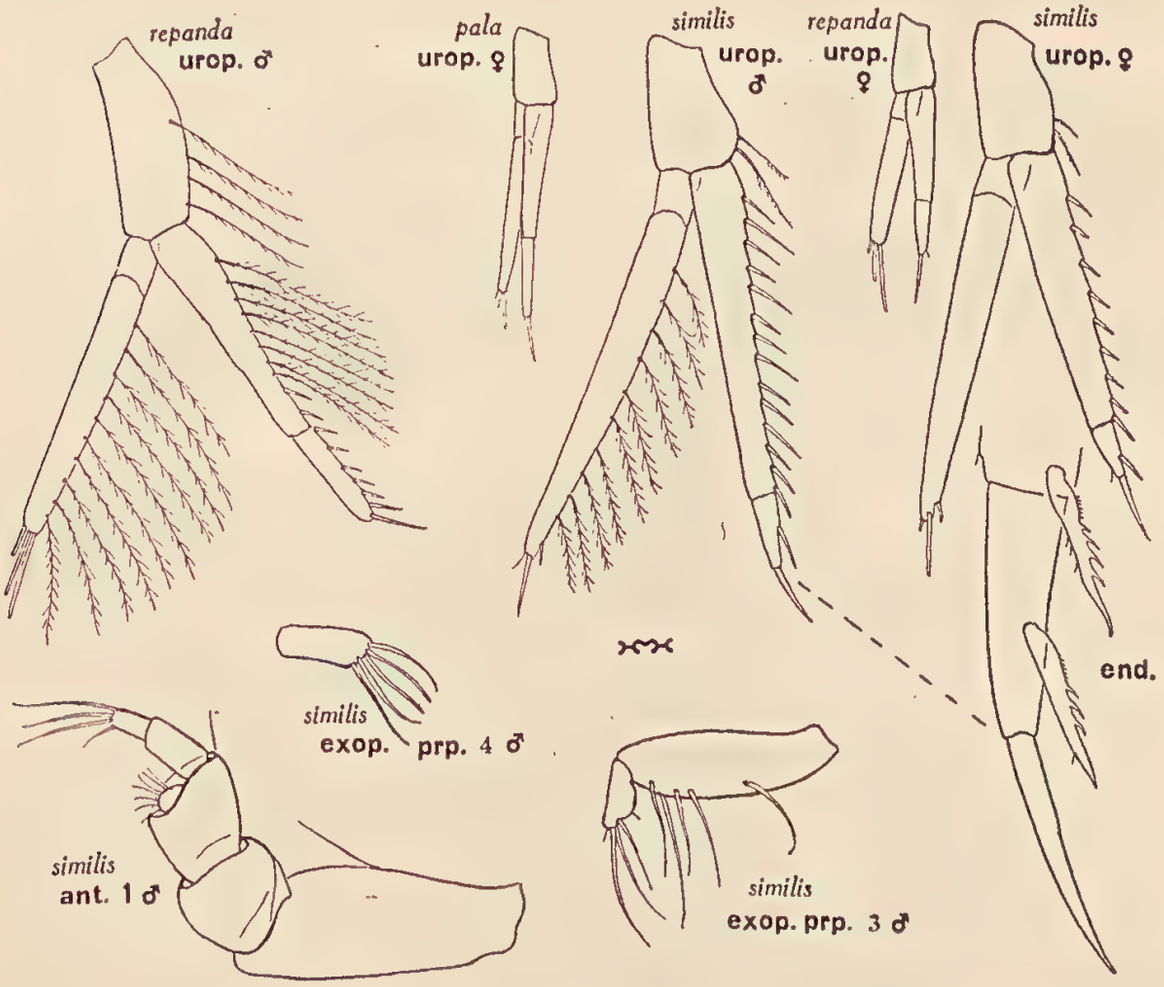

Fig. 3. *Gephyrocuma similis*; urop., uropods of types adult male, 2·8 mm., and ovigerous female, 3·1 mm. (× 86); end., distal segment of endopod (× 380); ant. 1, first antenna of male (× 172); exp. prp. 3–4, exopods of third and fourth peraeopods of male (× 172).

G. repanda; urop., uropod of ovigerous female, 2·4 mm., and adult male, 3·5 mm., from Garden Is., W. Aust. (× 86). *G. pala;* urop., uropod of ovigerous female, 2·4 mm., from S. Aust. (× 86).

Pedigerous somites together five-sevenths as long as carapace. Pleon more than half as long again as pedigerous somites together and nearly two-thirds as long as cephalothorax.

Peraeopods as in *pala,* the third pair with exopods consisting of two distinct segments, the fourth with unisegmentate exopods.

Peduncle of uropod one-half as long as first segment of endopod, which is a little shorter than exopod; inner margin of first segment of endopod with nine simple spines; second segment only one-fifth as long as first, with one inner spine and a distal spine which is one-third as long again as the segment.

Colour: translucent with a few scattered chromatophores. Length 3·1 mm.; ova 0·15 mm.

Adult male. Carapace one-third of total length of animal, deeper than wide and shaped as in *repanda*.

Pedigerous somites together five-sevenths as long as carapace. Pleon nearly twice as long as pedigerous somites and fully three-fourths as long as cephalothorax.

Peraeopods as in female. Peduncle of uropod less than half as long as first segment of endopod, which is almost as long as exopod; inner margin of first segment with fourteen irregular, curiously serrated spines (fig. 3, end.); second segment less than one-fourth as long as first, with one serrate inner spine and a simple terminal spine as in female.

Colour as in female. Length 2·8 mm.

Loc. Western Australia: Shark Bay, west of Cape Peron, 3 fathoms (G. P. Whitley, ex "Isobel", submarine light, surface temperature 18·55° C., August, 1945). Types in South Australian Museum, Reg. No. C. 3005 and 3222.

At first glance it might appear that the adults described above represent a form or race of *pala* in which the individuals have undergone more ecdyses than the shore-dwelling South Australian material, which includes egg-bearing females. It has been suggested that this may have happened in the case of *Dimorphostylis subaculeata* and its var. *praecox* (Hale, 1945, p. 185). In the case of *Gephyrocuma similis*, however, the proportions of the segments of the endopod of the uropod do not support such theory. The adult of *repanda* attains a total length of over 3 mm. but may be egg-bearing at 2·4 mm.; as noted above, in a small ovigerous female the first segment of the endopod of the uropod, in relation to the second joint, is approximately two-thirds as long as in an example 3 mm. in length. In a 2·4 mm. ovigerous female of *pala* the endopodal segments are 8 : 5 and on this basis should be at most 12 : 5 in the Shark Bay specimens if they were referable to *pala*, whereas in the ovigerous female of *similis* it is 25 : 5.

The armature of the uropods of *similis* is distinctive and the pleon is much longer in both sexes than in *pala*.

Genus LEPTOCUMA Sars.

LEPTOCUMA PULLEINI Hale.

Leptocuma pulleini Hale, 1928, p. 38, fig. 7–8; and 1936, p. 409; and 1944, p. 253, fig. 19–20.

A male taken by I. S. R. Munro at Noosa River, Queensland, extends the distribution of the species; its known range on South and Eastern Australian coasts is now between lat. 27.2 S. and 35.50 S.

LEPTOCUMA SERRIFERA Hale.

Leptocuma serrifera Hale, 1944, p. 261, fig. 24–25.

Originally described from one locality in New South Wales, the species proves to be not uncommon in Western Australia (Airlie Island off Onslow; Port Hedland and Esperance Bay, etc.). In the female the exopod of the uropod bears short, compound setae on the inner margin, not plumose setae as before stated.

LEPTOCUMA NICHOLLSI sp. nov.

Ovigerous female. Carapace robust, as wide as deep, and barely half as long again as deep; it is one-fourth of total length of animal; median dorsal carina sharply defined for anterior three-fourths of its length. Ocular lobe wider than long, only slightly pigmented and with lenses ill-defined. Antennal notch wide and angle very obtuse.

The five pedigerous somites together are longer than carapace and rather more than half as long as pleon.

Pleon, like pedigerous somites, smooth and, excepting fifth, subequal in length.

First peraeopod with carpus reaching to level of front of pseudorostral lobes; basis shorter than combined lengths of remaining joints, with a long seta at external angle and with four serrate spines, successively increasing in length backwards, and followed by a row of plumose setae of which also the proximal ones are longer than the others; dactylus long, almost as long as propodus, and slightly longer than carpus, which is equal in length to merus.

Second peraeopod reaching to about middle of length of merus of first leg; basis distinctly shorter than rest of limb, with plumose setae on both margins; carpus half as long again as ischium and merus together; propodus about two-thirds as long as dactylus and less than half as long as carpus.

Third to fifth peraeopods each with three distal carpal setae, at least the last two of which, together with the propodal seta, reach beyond tip of dactylus.

Peduncle of uropod slender, about one-third as long again as telsonic somite, and one-fourth as long again as the subequal rami; its inner margin is armed with seven stout spines, none differing markedly in length from the others; first joint of endopod half as long again as second, its inner margin with nine spines, four short followed by one longer at middle of length; beyond the latter are three short spines and a longer spine at distal end; second joint with four spines on inner margin, and with three compound setae at distal end; the middle (and most terminal) of these setae is as long as the joint, the inner one is half as long as this, while the outer is very short. Exopod with compound setae on both margins and distal end of second joint; the longest of the terminal setae is more than half as long as the exopod.

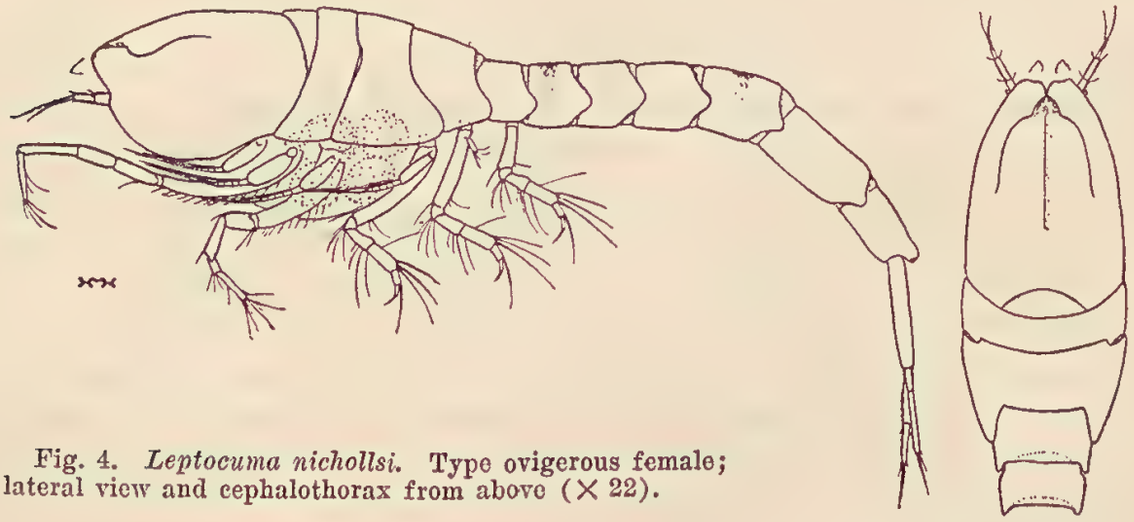

Fig. 4. *Leptocuma nichollsi.* Type ovigerous female; lateral view and cephalothorax from above (× 22).

Colour: translucent, except for a transverse dorsal brown marking on first and fourth pleon somites. Length 4·1 mm.; ova 0·2 mm.

Adult male. Carapace more than one-fourth of total length of animal, as wide as deep, and nearly half as long again as deep. The pseudorostral lobes do not extend forwards quite as much as in the mature female and are more widely separated. The ocular lobe is, as usual, larger and is more strongly pigmented, while the antennal notch is represented by a very shallow indentation.

The five pedigerous somites together are half as long as the pleon and almost as long as the carapace.

The peraeopods are much as in the female and the basis in the first pair similarly has four conspicuous serrate spines at distal fourth of inner margin.

Uropod relatively longer than in female; peduncle two-thirds as long again as telsonic somite, fully one-fourth as long again as the subequal rami, and with fourteen spines on inner margin; first joint of endopod half as long again as second; armature of rami as in female but the spines and setae are longer.

The first pleon somite has three dark brown chromatophores, arranged in a transverse line on the dorsum, and the fourth somite has two similar spots. In addition there is a pair of small dark chromatophores on the back of the carapace; otherwise the animal is translucent. Length 4·25 mm.

Loc. Western Australia; Garden Island, Careening Bay, 3 fathoms (A. G. Nicholls, submarine light, November, 1946). Type female and allotype male in South Australian Museum, Reg. No. C. 3072 and 3075.

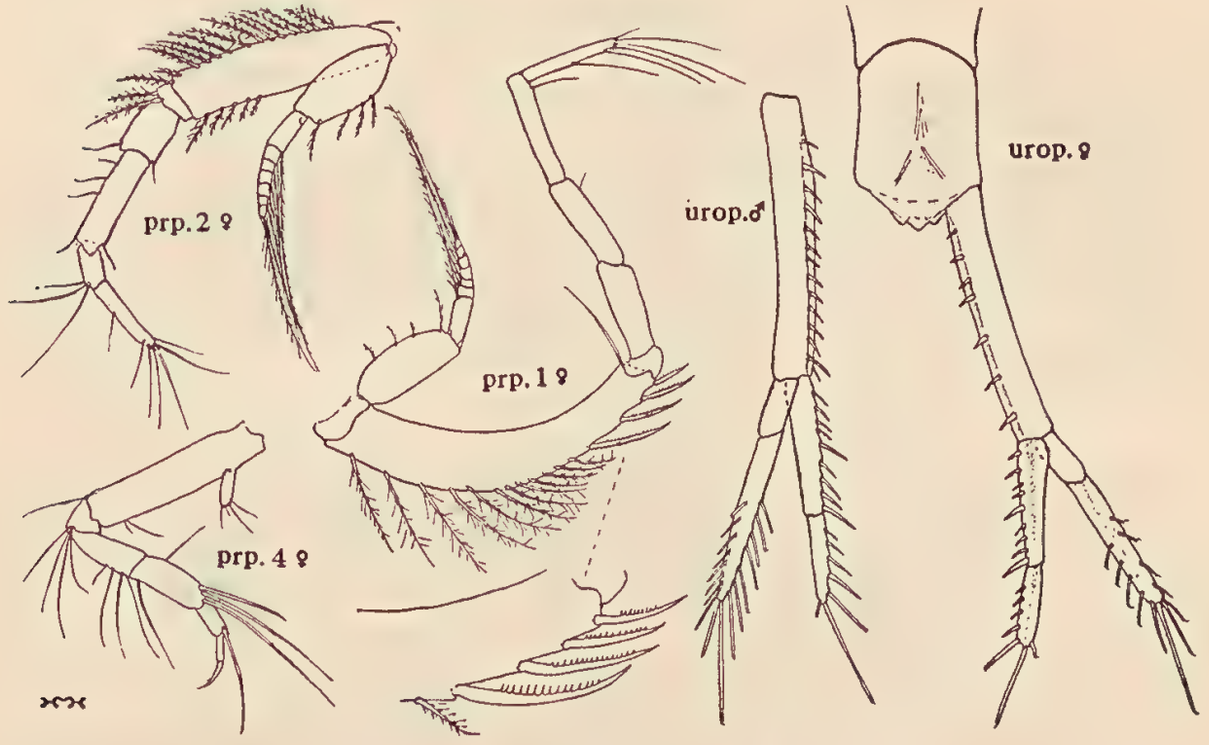

Fig. 5. *Leptocuma nichollsi.* Types ovigerous female and adult male; prp. 1, 2 and 4, first, second and fourth peraeopods (× 48; basis of first leg, ×.92); urop., uropods, etc. (× 48).

The types, together with eight adult males and five immature examples, were taken from a series of hauls made on the night of November 26–27, by Dr. A. G. Nicholls (after whom the species is named) and some of his students.

The four serrate spines at the distal end of the basis of the first peraeopod are constant in immature specimens as well as in adults. The dark markings on the first to fourth pleon somites are present in all examples, though the chromatophores may vary in number. The number of the colour cells on the carapace also varies, but not many are present in any of the material.

In the key to Australian species of the genus (Hale, 1944, p. 253) *nichollsi* would fall into the second section together with *obstipa, serrifera, sheardi* and *intermedia* were it not for the fact that there are four, instead of two, serrate

spines at the distal end of the inner margin of the first peraeopod. It differs from all the aforementioned species but *serrifera,* however, in that the second joint of the endopod of the uropod is much more than half as long as the first segment. In most other features it resembles *serrifera,* but may be separated by the character of the uropods (longer peduncle, and different armature of it and the endopod of the appendage) and the proportions of the joints of the first peraeopod.

Genus VAUNTHOMPSONIA Bate.

VAUNTHOMPSONIA NANA Hale.

Vaunthompsonia nana Hale, 1944, p. 266, fig. 28–29.

This species was described from a male 1·9 mm. in length, with the anterior peraeopods mutilated; as mentioned, it closely resembled *V. arabica* Calman (1907, p. 29, pl.vii, fig. 20–24), differing mainly in the smaller size and shape of the carapace.

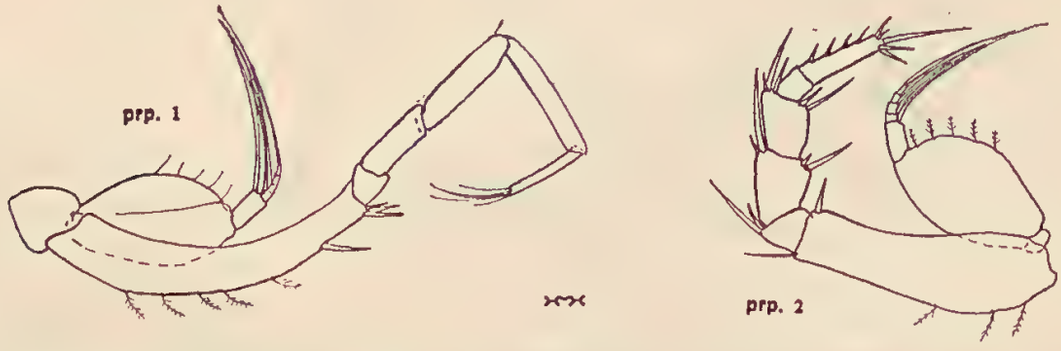

Fig. 6. *Vaunthompsonia nana.* First and second peraeopods of 3·1 mm. adult male from Western Australia (× 60).

Some further males from Western Australia raise doubts as to whether the South Australian type of *nana* should be regarded as a dwarf variety of *arabica.* The Western Australian males are larger than the type of *nana,* being 3·1 mm. to 3·4 mm. in length, and possess first and second peraeopods as illustrated for *arabica* (cf. fig. 5; and Calman, fig. 22 and 23), while the uropods also are very similar. The carapace, however, has the dorsal margin less arched than shown in Calman's fig. 20, and is as illustrated for the type of *nana* (Hale, 1944, fig. 28); Calman remarks of the carapace of his *arabica,* "seen from the side the dorsal edge is distinctly arched.... This species is very closely allied to *V. cristata,* but it appears to differ in a number of small characters, of which the convex dorsal edge of the carapace and the shorter first legs are the most

conspicuous.'' For the present it seems desirable to regard the Australian material as representing a form separable from *arabica* (Suez and Aden).

The Western Australian specimens were taken at Garden and Rottnest Islands, and at Esperance Bay. In all the pseudorostral lobes meet for a short distance in front of the eye-lobe (a condition not completely in accord with Stebbing's definition of *Vaunthompsonia*). The carapace has a faint median dorsal carina.

Genus SYMPODOMMA Stebbing.

Sympodomma Stebbing, 1912, p. 138, and 1913, p. 15; Hale, 1944, p. 284.

As previously noted (Hale, *ut supra*), five species are included here. The adult male is known in only two of them, *weberi* (Calman) and *australiensis* Foxon; in the case of *anomala* (Sars) the female alone has been described. A sixth species (from Western Australia) is here referred to the genus, but unfortunately this new form is represented only by adult males; further, the South Australian specimens previously referred to *S. africanus* Stebbing are now regarded as representing a distinct species.

Glyphocuma Hale (1944, p. 268) is close to *Sympodomma* and is separated mainly by a male character—the presence of an exopod on the fourth peraeopod, in that sex only, this being absent in the male of *Sympodomma*; for this reason a combined key of all the species placed in the two genera is given below. Because of the sexual dimorphism exhibited in the species referred to *Glyphocuma* and as it is probable that this occurs also in *Sympodomma*, the character of the dorsal crest of the carapace, an important distinguishing feature in females and young males, is necessarily ignored, but the key is based on details readily observable without dissection.

Stebbing does not designate or indicate a genotype for *Sympodomma*. It might be said that his *S. africanus* (the first-mentioned of the species which he groups as belonging to the genus) is excluded as a genotype because it is a ''species which the author of the genus doubtfully referred to it'' (Int. Rules Zool. Nomenclature, Art. 30, ii, e). Stebbing gives as the main distinguishing character of the genus, within its group, the presence of exopods on the first three pairs of peraeopods in both sexes, but later states that in the type young male of *S. africanus* ''Exopods to the third pair were not satisfactorily made out;'' no exopod on the third peraeopod is indicated in his figure.

In the circumstances *Heterocuma diomedeae* Calman (1912, p. 612, fig. 6–9) is now designated as the genotype of *Sympodomma*.

KEY TO THE SPECIES OF *SYMPODOMMA* AND *GLYPHOCUMA*.

1. First joint of endopod of uropod not longer than second 2
   First joint of endopod of uropod at least one and one-half times as long as second 6

2. Ocular lobe with two tiny divergent teeth at anterior end *S. anomala* (Sars)
   Ocular lobe with at most one median point at anterior end 3

3. Endopod of uropod longer than exopod .. .. *S. whitleyi* sp. nov.
   Endopod of uropod not longer than exopod 4

4. Front of ocular lobe produced to a point .. .. .. *G. bakeri* (Hale)
   Front of ocular lobe rounded 5

5. Peduncle of uropod twice as long as exopod. Endopod of uropod shorter than exopod and with its first joint equal in length to second *S. diomedeae* (Calman)
   Peduncle of uropod distinctly less than twice as long as exopod. Endopod of uropod at least as long as exopod and with its first joint shorter than second .. .. *G. inequalis* Hale

6. Front of ocular lobe produced to a point 7
   Front of ocular lobe rounded 8

7. Ocular lobe at most barely longer than wide, with lenses extending to base *G. serventyi* Hale
   Ocular lobe elongated, eye present at the extremity *S. australiensis* Foxon

8. Endopod of uropod slightly longer than exopod .. *S. africana* Stebbing
   Endopod of uropod a little shorter than exopod 9

9. Form slender. First peraeopod with the propodus fully as long as combined lengths of ischium, merus and carpus. Peduncle of uropod more than half as long again as either exopod or telsonic somite .. *S. weberi* (Calman)
   Form rather robust. First peraeopod with the propodus only about two-thirds as long as combined lengths of ischium, merus and carpus. Peduncle of uropod less than one-fourth as long again as exopod and little longer than telsonic somite 10

10. Pleon smooth laterally. External apical lobe of basis of third maxilliped not extending beyond distal end of merus .. .. .. *G. dentata* Hale
    Pleon with dorso-lateral, lateral and infero-lateral carinae. External apical lobe of basis of third maxilliped extending beyond distal end of merus *S. (?) incerta* sp. nov.

SYMPODOMMA WHITLEYI sp. nov.

Adult male. Integument well calcified. Carapace slender, fully one-fourth of total length of animal, barely deeper than wide, and more than twice as long as deep; surface smooth except for a distinct median dorsal carina, which

exhibits no indication of serrations; dorsal margin, as seen from side, almost straight. Antennal notch obliterated and angle very obtuse. Ocular lobe partly pigmented, barely longer than wide, none of the somewhat indistinct lenses projecting posteriorly beyond its hinder limits; in front the lobe has an almost imperceptible median projection. Pseudorostral lobes reaching apex of ocular lobe, and with anterior margins smooth.

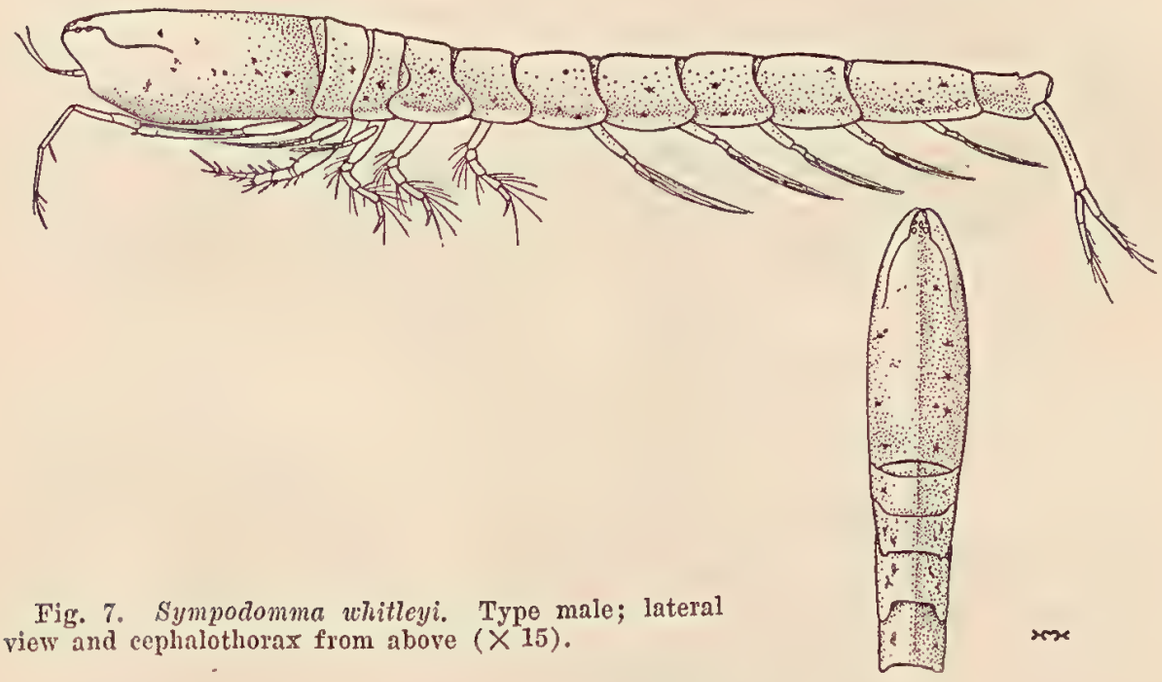

Fig. 7. *Sympodomma whitleyi.* Type male; lateral view and cephalothorax from above (× 15).

Pedigerous somites together not as long as carapace and less than half as long as pleon; each somite with an ill-defined median dorsal carina; antero-lateral angle of second overlapping carapace slightly, that of third overlapping second; laterally the fourth overlaps the third anteriorly and the fourth posteriorly.

Pleon smooth except for a low median dorsal carina on each somite; telsonic somite about two-thirds as long as fifth, with distinct dorsal notch.

First peraeopod with carpus reaching slightly beyond level of antennal angle; basis slender, subequal in length to rest of limb, margined with plumose setae and with a few spines on proximal fourth of inner edge; ischium with a strong tooth at inner apical angle; carpus a little shorter than propodus, equal in length to dactylus and about one-third as long again as merus.

Well-developed exopods are present on the first to third peraeopods, but there is no trace of exopod on the fourth leg.

Basis of second peraeopod shorter than rest of limb and with two blunt apical "spines" (compound setae); merus and carpus subequal in length, each

shorter than dactylus, which is more than three times as long as propodus; the longest of the terminal dactylar spines is fully as long as the dactylus; other armature of the limbs is shown in fig. 7, prp. 2.

Outer slope of carpus of fossorial limbs with long setae, the three distal of which, together with the single propodal seta, reach well beyond tip of dactylus.

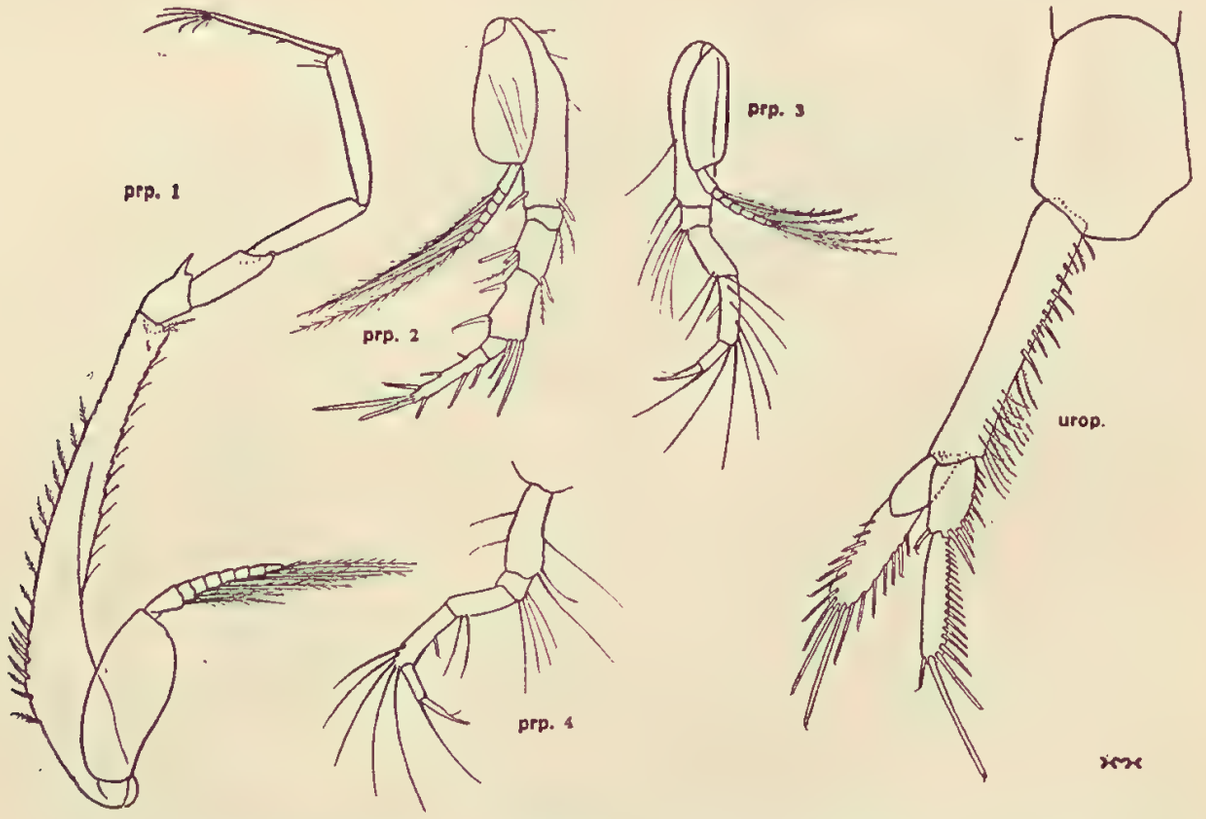

Fig. 8. *Sympodomma whitleyi.* Paratype male; prp. 1–4, first to fourth peraeopods; urop., telsonic somite and uropod (× 40).

Peduncle of uropod nearly one-third as long again as telsonic somite and one-third as long again as endopod, which is distinctly longer than the exopod; there are a few serrate setae on inner margin near proximal end, followed by ten spines, irregular in length, and in distal half two series of setae; first joint of exopod fully three-fourths as long as second, which is suboval in shape and is armed with stout compound setae on both margins, the longest of the apical ones being about as long as the joint; first joint of endopod fully two-thirds as long as second, armed on inner margin with ten spines, successively increasing in length between first and fifth, and between sixth (which is abruptly shorter than fifth) and tenth; there is a stout compound seta at outer apical angle; second joint with a row of fifteen spines on inner margin, successively increasing

in length; the rounded apex bears three compound setae, the longest of which is equal in length to the joint itself.

Colour white, with sparse black pigment spots as shown in fig. 7. Length 7·2 mm.

Loc. Western Australia: Shark Bay, Monkeymia, 2 fathoms, sand and weed bottom (G. P. Whitley, ex cutter "Isobel," submarine light, November, 1945, temperature 24·52° C.). Type in South Australian Museum, Reg. No. C. 3085.

In the closely allied genus *Glyphocuma* the male of *G. bakeri* somewhat resembles that of *S. whitleyi*; incidentally the two species were taken together in the submarine light trap noted above, *G. bakeri* being present in great number. *S. whitleyi* may be readily separated from the last-named, for, apart from the generic character, it is of smaller size, has the uropod of quite different proportions with endopod longer than exopod, while the eye-lenses do not extend posteriorly beyond the hinder limit of the ocular lobe.

SYMPODOMMA (?) INCERTA sp. nov.

Sympodomma africanum Hale (*nec* Stebbing), 1928, p. 40, fig. 9–10 and 1944, p. 284, fig. 30, D.

Unfortunately no further material of the southern Australian species formerly recorded by me as *S. africana* has come to hand; abortive attempts to collect additional specimens by Agassiz Trawl were made on several occasions over the area in St. Vincent Gulf on which the known examples were taken.

The inclusion of this form in the composite key given above necessitates its recognition, at least provisionally, as a species distinct from the African species of *Sympodomma*. As the male of *incerta* is unknown, its inclusion in *Sympodomma* is open to question; in fact, the feebly expanded merus of the third maxilliped, if it be a reliable generic indicator, suggests that the species may prove to be referable to *Glyphocuma*.

S. africana Stebbing (1912, p. 138, pl. 1) is known only from a subadult male and *incerta* from subadult females. Characters separating the Australian specimens from *africana* were noted previously (Hale, *ut supra*, 1928). At the time it was considered that the differences were due to age and sex, but subsequent examination of many more Cumacea has led to reconsideration of this view (Hale, *ut supra*, 1944).

It will be noted that in the above key, *incerta* falls close to *Glyphocuma dentata* but is separable by the features there detailed; as already noted the character of the dorsal crest of the carapace is ignored in this key. The females of the two species exhibit considerable difference in this respect, *dentata* having the crest cut into from nine to twelve teeth, while *incerta* has only four teeth,

the anterior three large, the last one tiny. However, in the case of *Glyphocuma bakeri* (which see herein) examples from Shark Bay (lat. 25.30 S.) have fewer dorsal serrations than are found in southern Australian specimens (lat. 34.5 S. to 38.21 S.).

Genus GLYPHOCUMA Hale.

GLYPHOCUMA SERVENTYI Hale.

Glyphocuma serventyi Hale, 1944, p. 280, fig. 37–38.

This species was known previously only from the Pacific Coast of Australia. Examples are now available from Careening Bay, Garden Island, in Western Australia.

GLYPHOCUMA BAKERI Hale.

Sympodomma bakeri Hale, 1936, p. 396, fig. 3–4.

Glyphocuma bakeri Hale, 1944, p. 270, fig. 31–32.

A large number of examples, mostly males, were taken at three localities in Shark Bay, Western Australia, by G. P. Whitley, in November, 1945, by

Fig. 9. Carapace of immature female of *Glyphocuma bakeri* from Shark Bay, showing robust form and relatively large teeth of dorsal crest (× 44).

means of submarine light traps, in 2–3 fathoms on sandy and weedy bottoms. The adult males, 9·2 mm. to 10 mm. in length, are as described previously (Hale, 1944), but the females, adults and immature examples, differ from females taken in southern Australia, in having only six or seven serrations in the anterior half of the crest of the carapace, these teeth being larger than in the southern examples; those of an immature female (fig. 8) are still larger than

those of the mature Shark Bay females. This young female, 7·25 mm. in length, has the carapace relatively much deeper than in older females and so, with its rather large dorsal teeth, superficially resembles the adult female of *G. dentata* (Hale, 1944, p. 273, fig. 33–34). The last-named, however, has smaller eyes, restricted to the anterior portion of the ocular lobe, the front of which is not produced to a point, the second joint of the endopod of the uropod is much shorter than the first, etc.

SUMMARY.

The paper deals with further Australian Bodotriidae, mainly from Western Australia. Apart from fifteen species of *Cyclaspis* (dealt with by the author in a previous paper) only two members of the family were formerly known from the Indian Ocean coast of Australia; nine species are added herein, including three which are described as new, viz. *Leptocuma nichollsi, Gephyrocuma similis* and *Sympodomma whitleyi.*

A species recorded from South Australia as *Sympodomma africana* Stebbing is now regarded as distinct and the name *Sympodomma* (?) *incerta* is proposed for it.

A composite key to the species of *Sympodomma* and *Glyphocuma* is given.

REFERENCES CITED.

Hale, Herbert M. (1928): "Australian Cumacea". *Trans. Roy. Soc., S. Aust.*, lii, pp. 31–48, fig. 1–17.

Hale, Herbert M. (1936): "Three New Cumacea from South Australia". *Rec. S. Aust. Mus.*, v, pp. 395–403, fig. 1–6.

Hale, Herbert M. (1944): "The Family Bodotriidae". *Trans. Roy Soc., S. Aust., lxiii*, pp. 225–285, fig. 1–38.

Stebbing, T. R. R. (1912): "The Sympoda" (Part VI of S.A. Crustacea for the Marine Investigations in South Africa). *Ann. S. Afr. Mus.*, x, pp. 129–176, pl. i–xvi.

Stebbing, T. R. R. (1913): Cumacea (Sympoda). *Das Tierreich*, Lief. xxxix, pp. 1–210, fig. 1–137.

Zimmer, Carl (1914): Fauna Südwest Aust., v., Cumacea, pp. 175–195, fig. 1–18.

SANDTUBE FULGURITES

AND THEIR BEARING ON THE TEKTITE PROBLEM

By CHARLES FENNER, South Australian Museum.

Plates vii–xi and Text Fig. 1.

PRELIMINARY NOTES.

Sandtube fulgurites are in themselves rare and interesting things. As will be shown, they are found all over the world, wherever the occurrence of sand-dunes and electrical storms combine to provide the conditions requisite for their formation.

Although these conditions exist widely over arid and semi-arid interior areas and along the sea coast of all the lands of the world, a relatively small number of fulgurites has been preserved in museum collections, or recorded in scientific literature. The bibliographies of papers referred to show that these objects have aroused interest and speculation for the past 200 years.

Only four fulgurite occurrences have been found in Australian records: Knibbs and others, New South Wales, 1898 (ref. 1); J. C. Verco, South Australia, 1907 (ref. 4); E. S. Simpson, Western Australia, 1931 (ref. 3); and T. H. Connah, Queensland, 1947 (ref. 2).

The British Museum mineralogical collections record four interesting occurrences, dating from 1812 to 1893. Dr. Campbell Smith, Keeper of Minerals, informs me that these specimens were all found in England, and were in all cases of the siliceous type.

Enquiries from Australian Universities and Museums show also that relatively few specimens have been preserved, though at a small number of places they were once abundant, as in the Sydney sandhills, Moreton Island, Queensland, and Port Macquarie, New South Wales, these being apparently the accumulated relics of countless electrical storms.

There are other types of mineral specimens that are due to fusion by lightning, and these also are called fulgurites by some authors. The chief one is a glassy surface due to the fusing of a rock face on high mountains; other forms are found in crumbled rock material on mountains. It has been suggested that the word fulgurite should be reserved for the more striking forms known as "sand-tube fulgurites". It may be that Macedon Glass (Baker and Gaskin, ref. 5) belongs to the second type of lightning-fused rock.

The writer's interest in fulgurites arose from investigations into the problem of the origin of tektites, particularly australites, and other natural occurrences of silica glass. Long ago J. W. Gregory, Frederick Chapman, and other workers suggested a fulguritic origin for tektites, but the weight of evidence, particularly of the distribution, composition, and shapes of australites and other tektites was so overwhelmingly against such a theory that it was discarded.

In 1940, however, Virgil E. Barnes, investigator of the first true tektites to be found in North America, returned to the electrical fusion theory of origin. In the concluding paragraph of his paper on "North American Tektites" (ref. 12) he writes: "If, as practically all the evidence now indicates, tektites *are actually proven to be fulgurites,* then the word tektite should not be used for these objects, but should be held in reserve in case a glass meteorite is ever found."

Professor Barnes is admittedly no dogmatic exponent of the "lightning hypothesis" for tektites, but wishes (he writes) to create interest "to cause the investigation of all the terrestrial possibilities before accepting the meteoritic origin (for tektites) with all its unproven and unprovable postulates".

This challenging statement provides an additional reason for further enquiry into the forms, distribution, composition, etc., of fulgurites, since the latter are known to be terrestrial and due to fusion by lightning.

RECORDED AUSTRALIAN FULGURITES.

South Australia. The following account of a fulgurite is given in the Proceedings of the Royal Society of South Australia (ref. 4): A portion of this fulgurite is preserved in the Tate Museum, University of Adelaide, and is shown in photograph, Plate vii: "The President (Dr. J. C. Verco) exhibited a fulgurite or lightning tube. The portion shown was 18 centimetres (about 7 inches) long and 33 millimetres (about 1⅓ inches) in diameter. The wall of the tube was about 1·5 to 2 millimetres in thickness, and was composed of fused sand, smoothed and glazed on the inner surface, rough like sandpaper outside, and longitudinally folded in about seven nodose corrugations. It was very brittle. This fulgurite was given to Dr. Verco by Mr. Whitton, of Warrina, near Oodnadatta, who supplied the following particulars: At the end of November, 1902, a severe thunderstorm passed over the district, and a tremendous explosive report was heard, attended by a marked vibration of the ground. The next day a black boy found, about three-quarters of a mile from the station, a stunted mulga-tree, one of whose branches was split and charred, and immediately below there was a depression in the sand. Groping in this he found a piece of sand tube, and took it to the station. Mr. Whitton visited the spot

and followed the tube down for about 12 feet, beyond which he could not go, because the sand rolled in as fast as he threw it out. The tube stood in almost a vertical position, and varied but little in diameter, and in the thickness of its walls."

Western Australia. Dr. E. S. Simpson (ref. 3) records: "On April 6, 1931, Mr. G. E. Watts, of West Popanyinning, had the good fortune to observe the formation of a fulgurite. During the course of a severe thunderstorm he saw a violent flash of lightning strike some sandy ground about 400 yards away, and thereafter smoke or steam rising from the ground where it was struck. On investigation he found the ground blackened and still hot over an area of about 20 cm. (8 inches) in diameter, and digging revealed a core of lechatelierite (fulgurite) in the soil. This core was hollow and very brittle, and extended downwards for about a metre (3 feet approximately), small branches radiating from it at several points." An analysis of this fulgurite and a description are elsewhere included in this paper.

New South Wales. In 1898 Messrs. Knibbs Grimshaw and Curran (ref. 1) investigated fulgurites *in situ* at the Kensington Sandhills, Sydney, New South Wales. Their report shows that most of the specimens found were near the top of a high sandhill. Excavations proved them to be very much branched, that the tubes went downwards at varying angles, and that the line followed by the tubes was very irregular, both in the vertical and the horizontal planes. The tubes were whiter in colour than the surrounding sand. Knibbs was of the opinion that the small amount of limonite in the sand was volatilized by the intense heat of fusion, and condensed in the sand immediately surrounding the fulgurite.

Queensland. A fulgurite was completely excavated from the sand dunes at the southern end of Moreton Island by Mr. V. F. Kenna (Connah, ref. 2). "The specimen, which occurred practically vertical in the sand, has a total length of 5 feet 1 inch, with a bifurcation 9 inches from the lower end. The main stem of the fulgurite (shows no branching except at the end and) exhibits a flattened and fluted cross-section varying from ½ inch to 1 inch by 1/10 inch. The widest sections are at the top and immediately above the branch, where the width is 1 inch. Below the bifurcation the width of each branch is reduced to ½ inch, with rapid decrease in size to 1/5 inch at the extremity."

PHYSICAL DESCRIPTIONS OF FULGURITES.

The writer has had the opportunity of examining, by the courtesy of colleagues in the various universities and museums of Australia, over 120 fulgurite specimens. These have come from all the Australian States except

Tasmania, as well as from North Carolina, Michigan, and Wisconsin, U.S.A. The information thus obtained has been supplemented by descriptions given in available references.

The accounts given by Darwin (ref. 6), Merrill (ref. 7), Rutley (ref. 8), Julien (ref. 9), and others hereafter noted, provide evidence that the sand-tube fulgurites, in whatever country they have been found, have had the same general mode of occurrence, and present the same general features, with the same type of occasional minor variations.

The exterior of the sandtube fulgurite is usually light grey in colour, but varies from opaque white to very dark grey. The interior or lumen is lined by glass, almost always pure silica (? lechatelierite), showing the glaze which glass-blowers describe as "hot polish". This glass is usually 1 mm. thick, but in rare cases is as much as 2 mm.; it may contain small bubbles, *vide* Julien (ref. 9). This passes into more highly vesicular material, where the gas bubbles are larger and are mixed with fused or semi-fused sand grains, mostly quartz, but occasionally felspar or iron oxides. The exterior is also characterized by a series of sub-parallel "ridges", "flanges", or "wings", and some adherent unfused sand.

The size of the tube is usually greater at the point of origin, the surface of the sand-dune or sand-plain. Merrill (ref. 7) records a case where the tube enlarged downward. In some cases the lumen is from 2 cm. to 3 cm. in interior diameter. The most common diameter of the lumen is about 1 cm., tapering as the tube bifurcates or branches. The tube usually branches downwards, after the fashion of lightning flashes (ref. 1), but some are almost straight (ref. 2), and some have been found apparently parallel with the surface (ref. 7).

The lumen, or glazed interior of the tube, tends in cross section towards an irregular circle, but is never circular. The process of sketching the outline of a large number of sections, backed by figures such as that given by Merrill (ref. 7), reveals an occasional tendency towards a hexagonal shape, with a ridge or flange at each angle of the hexagon. Nevertheless, the cross sections are extremely varied in shape. The "flattened" tubes, often called "collapsed", are common, apparently in the lower portions of sandtubes; but I have seen one specimen, over 3 cm. in the longer diameter of the section, that appears from its size to have come from somewhere near the point of origin of the fulgurite. Small tubes and flat tubes appear in general to come from the lower parts of the fulgurite, as suggested by Rutley's figure (ref. 8), and by the specimens investigated.

The open lumens have, as has been supposed from the beginning of fulgurite records, doubtless been formed by expanding gas. It is usually

assumed that this gas was water, but Merrill's observations suggest that it may have been heated air; there is also the possibility of some gaseous SiO_2. There is no evidence that the flat type of tube is due to collapse; examination of many sections leads me to the idea that the cross section is the reflection of some quality (strength, movement, dispersion, etc.) in the electric charge.

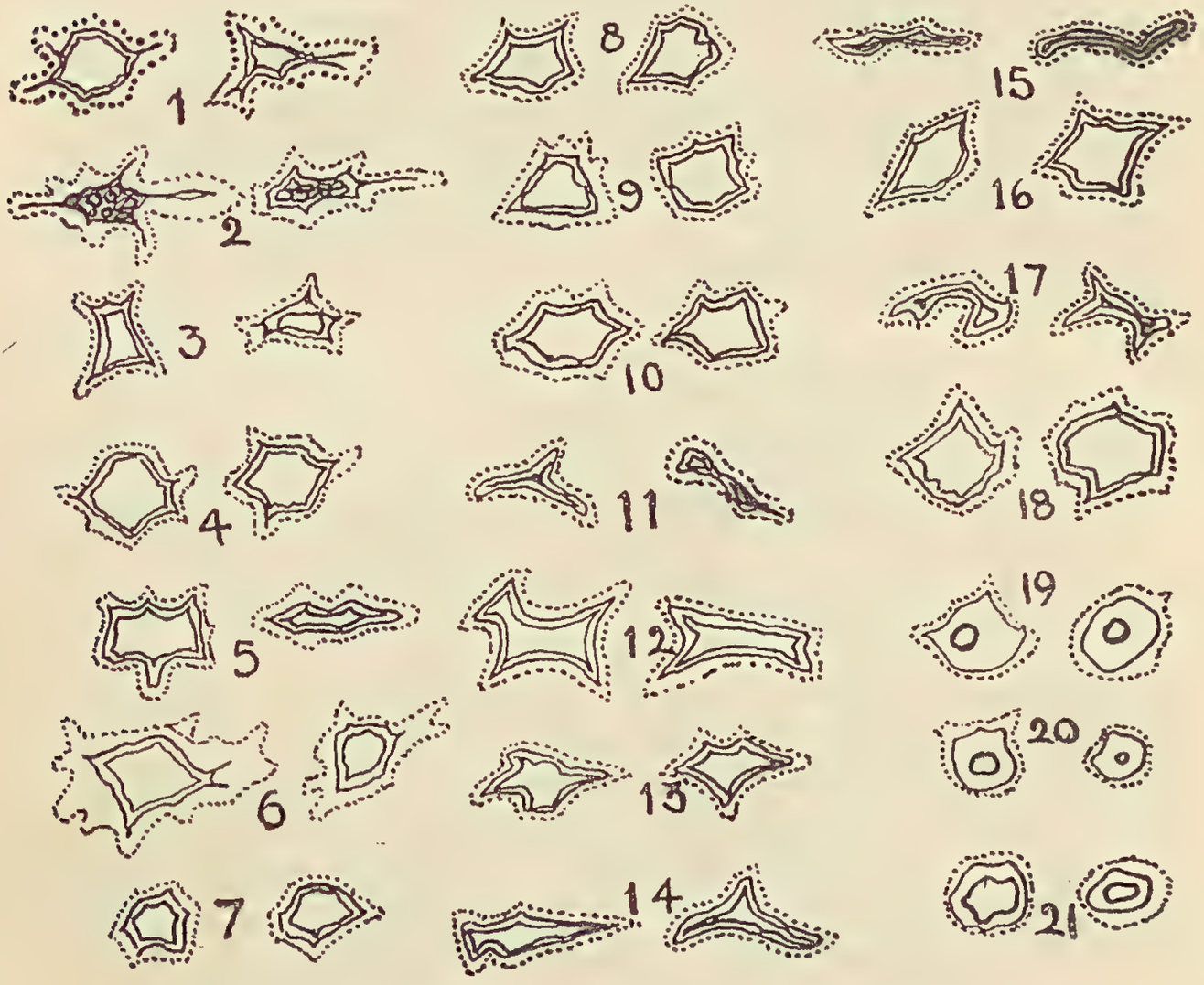

Fig. 1. Cross sections of sandtube fulgurites described in the context. In these sketches the inner line represents the open lumen; the next line represents the limit of the glass, which is rarely more than 1 mm. thick; the external dotted line represents the exterior shape of the sandtube, with ridges, papillae, etc. Nos. 1 to 18, as elsewhere described, are natural sandtube fulgurites; Nos. 19, 20, 21 are artificial sand-glass tubes.

It is suggested that a closer examination of the shapes of open tubes, with their curious variations as shown in fig. 1, and of the sub-parallel, discontinuous flanges or ridges, which sometimes show a perceptible spiral tendency, may throw some light on the qualities or properties of the electric current that formed them.

Interesting information is obtainable, as will be seen later, from "artificial fulgurites", whether these have been made by accidental short circuits in electrical transmission lines, or by careful laboratory experiment. Artificial fulgurites have some characters in common with natural fulgurites, but they lack the wide lumen and the external ridges. In lightning we have a prodigiously powerful electric current acting for an infinitesimal fraction of a second. In the artificial fulgurites that have been examined by me the current has been less powerful and the period of its action longer.

In order to obtain a general idea of the shapes of lumens, about 200 of them were sketched. A selection of 21 pairs is shown in fig. 1. By a "pair" is meant the lumens at the two ends of one segment; these often differ greatly. Since fulgurites are very brittle objects, the segments preserved are usually from 7 to 10 cm. in length. The segments of which the lumens have been figured are described as follows:

1. Port Macquarie, N.S.W. Tube large, slightly tapering, flattened towards one end, heavily corrugated and papillated; 4 main ridges up to 8 mm. high; many small bubbles in glass; adherent semi-fused quartz grains.

2. Port Macquarie, N.S.W. Large, flattened, and tapering; heavily corrugated, many sub-parallel and sub-spiral ridges; not a single lumen but collection of small ones, more glass than usual; adherent semi-fused quartz grains.

3. Port Macquarie, N.S.W. Small, with abundant ridges, low but definite and of unusual pattern, with dichotomies; opaque adherent sand; naturally the ridges are at the angles of the lumen and the glassy material extends as a line of glass, sometimes with bubbles, into the ridge or flange.

4. Queensland. Medium size segment; shape of lumen tends to be hexagonal, glass as usual about 1 mm. thick; high, solitary, irregular ridges, with papillae and "spikes" (small pointed excrescences); tube more translucent than usual.

5. Queensland. Lumen large one end, flattened towards the other; ridges few and unusually high; tube almost transparent in bright light.

6. Near Springsure, Queensland. Large tube, open winding lumen; extremely corrugated and papillated, with sub-parallel ridges; glass thicker than 1 mm. in places.

7. Queensland. Small tube, can be seen through from end to end; papillated, with a few low spiral-cum-parallel ridges; lumen relatively large.

8. Bondi, N.S.W. Tube very fragile, perforated, with little adherent sand; low papillae rather than ridges; tube bent sharply at one place, about 130 degrees.

9. Bondi, N.S.W. Tube very sandy and dark-coloured, very irregular in

shape, ridges and papillae abundant; lumen varies greatly in shape in cross section.

10. Van Buren County, Michigan, U.S.A. Longitudinal ridges, sub-parallel, with spiral tendency, papillae (rounded excrescences) and spikes (sharper excrescences).

11. Michigan, U.S.A. Tubes much flattened; heavily ridged, sub-parallel, lumen small or imperceptible, silica-glass extends up the central part of each flange or other projection.

12. West Popanyinning, W.A. Portion of the "lechatelierite" analysed and critically described by E. S. Simpson (ref. 3); lumen varies rapidly in shape, ridges very definite and irregular; among adhering quartz grains there appear to be some yellow-brown felspar grains.

13. Bronzewing, Victoria. Broken and irregular thin glassy tubes, iron-stained exterior; glass white and opaque looking; less ridged and papillated than usual, little adherent sand.

14. Michigan, U.S.A. Flattened and irregular tubes; highly rugose and knobby exterior; breaks show the usual highly glazed "hot polish" interior.

15. Dare County, North Carolina, U.S.A. A good example of the flattened tube; lumen almost non-existent; glass extends as a double face into all ridges and projections, as is usual.

16. North Carolina, U.S.A. Characteristic specimen, wide, open, irregular-shaped lumen, with glassy interior; exterior ridged and papillated, with usual fused adherent sand-grains.

17. Moreton Island, Queensland. Extremely irregular fulgurite, much flattened and heavily ridged; interior smooth but undulating, as is usual; occasional small black specks in the glass and in the sandy exterior.

18. Moore Park, Sydney. Large tube, wide open lumen, glass of tube about 1 mm. thick, passing as is common into vesicular and granular layers, with fused and semi-fused sand adhering; ridges abundant, sub-parallel.

19, 20, 21. These specimens are "artificial fulgurites"; the lumen is much smaller in relation to the whole tube; the glass is much thicker, 3 mm. and more. Ridges and corrugations do not occur, but there are a few sharp projecting spikes. Apart from occasional branchings and bulgings the surface is smooth and covered by sand-grains. No. 21 was made by Professor Sir Kerr Grant in his laboratory; Nos. 19 and 20 were forwarded by Professor de Courcy Clarke, of Western Australia, and were caused by an electric short in transmission lines in sand-dune country. Further note of artificial sandtubes is made in subsequent paragraphs.

CHEMICAL COMPOSITION OF FULGURITES.

The composition of rock-face fulgurites has been shown to be approximately that of the rock that has been fused. Sandtube fulgurites are of practically the same composition as that of the sands in which they were formed. The first spectro-chemical examination of a fulgurite is here presented, also its radio-active reaction.

The first analysis of an Australian sandtube fulgurite was that recorded by Knibbs, Grimshaw, and Curran (ref. 1); analysis by J. M. Curran. This was: SiO_2 93·4%, Al_2O_3 5%, Fe_2O_3 trace; specific gravity 2·1.

E. S. Simpson (ref. 3) made a complete analysis of a sandtube fulgurite, "Lechatelierite," from West Popanyinning, W.A., as follows: SiO_2 88·46%, TiO_2 ·46%, Al_2O_3 6·69%, Fe_2O_3 1·16%, MnO trace, MgO ·17%, CaO ·17%, Na_2O ·01%, K_2O 2·68%. Total, 99·80. S.G.: 2·21. N.: 1·465. The relatively high alumina and potash may be due to the sands being felspathic.

Geo. P. Merrill (ref. 7) had analyses made of sandtube fulgurites from U.S.A. localities, also of the sand in which they were formed. The glass proved to be more siliceous than the sand. The analyses made by Professor Clarke showed: (a) Fulgurite glass: Ignition ·33%, SiO_2 91·66%, $Fe_2O_3+Al_2O_3$ 6·69%, CaO ·38%, MgO ·12%, K_2O ·73%, Na_2O ·77%; (b) Surrounding sand: Ignition 1·01%, SiO_2 84·83%, $Fe_2O_3+Al_2O_3$ 9·88%, CaO 1·16%, MgO ·13%, K_2O 1·13%, Na_2O 1·50%. Merrill also makes reference to Wichmann's percentage of SiO_2 in fulgurite glass from three separate European localities; these were respectively 96·44%, 94·26%, and 91·23%; also to Harting's analysis, with its high percentage of carbonaceous material: SiO_2 90·2%, Al_2O_3 0·9%, Fe_2O_3 0·7%, CaO 0·1%, MgO 0·5%, K_2O 0·5%, Na_2O 0·6%, carbonaceous matter 5·6%, insoluble in HCl 0·9%.

By the courtesy of Professor Prescott, of the Waite Agricultural Research Institute, a spectrochemical examination was made of a South Australian sand-tube fulgurite and also of the associated sand. The report supplied by Dr. C. S. Piper is as follows: "Mr. A. C. Oertel, of the C.S.I.R. division of soils, has made a spectrochemical examination of the sandtube fulgurite glass and the sample of sand submitted. The spectrograms obtained of the two samples were essentially similar and only minor differences mentioned below could be detected. Quantitative spectrochemical analysis of substances differing from those with which we are usually working is not easy because of the absence of suitable reference standards. Mr. Oertel has therefore classified the elements found (other than the main component, silica) into two concentration groups only:

"Present in both samples in concentrations of 10^{-2} to 10^{-4}, i.e. between 1·0% and ·01%; Al, Fe, Mg, Ti. Titanium was somewhat higher in the

fulgurite than in the sand. The other elements were present in similar amounts in both samples.

"Present in both samples in concentrations of 10^{-4} and 10^{-6}, i.e. between 100 and 1 part per million: Ca, Cr, Cu, K, Mn, Na, Pb. Potassium was somewhat higher in the fulgurite than in the sand. The other elements are present in similar amounts in both samples. A small amount of tin, of the order of 1 to 100 parts per million, was detected in the sand; none was noted in the fulgurite. The possibility of contamination with tin before the sample reached us should be excluded before accepting the presence of tin. The above results indicate that the two substances are similar, being essentially siliceous material with only minor amounts of metallic components."

Radioactivity. Facilities being available to test radioactivity, fulgurites from Michigan, U.S.A., Port Macquarie, N.S.W., and "artificial fulgurites" were tested. All specimens proved to be without trace of radioactivity. Having in mind the comparison of fulgurites with tektites, a large oval Australite was tested at the same time; this specimen proved radioactive, giving a total count (i.e. beta particles plus background) of 10·5 per minute with a background of 7·5. No standards were available to allow calculations of the radium equivalent. This is of interest when considered with the fact that V. S. Dubey, of the Benares Hindu University (Nature, October 28, 1933, p. 678), found that australites, billitonites, and moldavites were radioactive to an extent that led him to believe that further investigation should throw some light on the mystery of the origin of tektites.

Reverting to the question of chemical composition, and leaving out of account the supposed "limonitic fulgurites" which have not been proved to be of fulguritic origin, the above evidence, plus hand and lens examination of a considerable number of sandtube fulgurites, suggests that they are almost wholly SiO_2 plus small amounts of the oxides of iron and aluminium, with interesting minute traces of other elements as shown.

ARTIFICIAL FULGURITES.

As early as 1828 Beaudant (*vide* ref. 1) made small fulgurites by passing an electric current through a mixture of powdered glass and salt. Since then many experimenters, with more powerful current available, have made artificial fulgurites with sand. In July, 1948, the writer saw in Adelaide an M.G.M. film entitled "Light and Power". It dealt with various aspects of electric power and among other things showed a high electric discharge passed through a small mound of sand; a fulgurite was formed, heavily branched and apparently with anastomosing branches (which occur, but not commonly, in natural fulgurites).

Following upon this, Professor de Courcy Clarke, of the University of Western Australia (June, 1948), sent the author a specimen of sandglass, 18·5 cm. long, and an irregular oval in cross section 6 cm.×8·5 cm. This was not a tube, but the central part was a highly vesicular dark glass. The bubbles were very large and showed the characteristic highly glazed interior as in fulgurite tubes. The exterior was covered with sand grains, partly fused, with rounded edges. Professor Clarke said it had been formed by the shorting of one of the electric mains near Cottesloe, Western Australia, the voltage probably being between 3,500 and 6,600 volts.

Later (September, 1948) Professor Clarke, by the courtesy of Mr. E. C. Plues, the distribution engineer of the State Electricity Commission, sent a number of specimens of artificial fulgurites with the note: "Fused sandy soil from Welshpool adjacent to the position of fallen high voltage wire (copper); approximate pressure from ground to wire, 12,000 volts." The glassy tubes "did not form right at the surface, but began about three inches underground where the soil began to get moist. Quite a string of them was formed all pointing in the direction of the power supply and tending to deviate downwards, possibly to a damper layer".

These specimens have been carefully examined and some of them are figured herein. The notable thing about them, apart from their similarity to natural fulgurites, was the difference therefrom. The glass of the tube was much thicker than in natural fulgurites, the tube in some cases being practically filled up with glass; there was a complete absence of the second most characteristic feature of fulgurites, namely, the sub-parallel flanges or ridges. In some cases these tubes bulged out or ended in long bubbles, shaped somewhat like the bulge in a small pipette; they were all encrusted with partly fused quartz sand. Their similarity to natural fulgurites lay in the fact that they were sand-encrusted glassy tubes of silica, much bent and branched, and with occasional sharp "spikes" extending outwards up to a length of 8 mm.

Meantime (August, 1948) the writer approached Professor Sir Kerr Grant, of the University of Adelaide, who willingly agreed to co-operate in the experiment of making natural sand-glass tubes. He found the most effective method to be as follows: Damp beach sand was enclosed in a glass tube about 1 inch diameter and 3½ inches long. Through this an electric discharge of up to 15,000 volts was passed, and some very interesting tubes were produced. One of the most attractive was a small tube which divided into four branches; this specimen was perfect when handed to me, but was very fragile and broke before being photographed (see Plate xi). Most of the other tubes were larger; they were rounder and smoother than natural sandtube fulgurites, with much thicker

glass, no external ridges, but with branchings and with occasional bulges and some "spikes".

The conclusion, so far as these specimens are concerned, is that silica-glass tubes can be experimentally or accidentally produced by the power of electric current developed by man. But, because of the very high voltage of "strikes" from electrical storms, and the minute period of time of their operation, natural sandtube fulgurites differ materially from artificial ones in the thickness of the glass surrounding the lumen and in the absence of exterior ridges or flanges.

GENERAL CONSIDERATIONS.

The earliest record of sandtube fulgurites (1711) appears to be that made by Pastor Hermann, of Massel, Silesia, who seems to have thought them to be akin to fossils. During the next forty years Fisher, Bucholz and Demarest discovered and demonstrated their electrical (lightning) origin. Beaudant and others, in the early nineteenth century, first produced artificial electrically-formed silica-tubes. Darwin (1833) was attracted by these curious objects at Maldonato, South America, as Friedrich von Humboldt (1821) had earlier been interested in those of Mexico.

Although these objects have been found all over the world, they are mainly in coastal areas. This is doubtless associated with the common occurrence of coastal dunes. But they appear to select certain areas. In Australia, for instance, they are more commonly found at Port Macquarie and Sydney, New South Wales, at other places on the "North Coast" of New South Wales, and at Moreton Island, Queensland. In the United States of America there are more references from Michigan, Wisconsin, North Carolina, and California than elsewhere. They occur also in inland areas, as in Central Australia, the Libyan and Sahara Deserts, etc.

It is useless to theorize about their places of occurrence until these are more clearly and more completely recorded. For instance, consider Port Macquarie, some 250 miles north of Sydney. Mr. H. F. Whitworth writes me (21/6/48) that the late Mr. Edwin Dick, a resident of that district, collected "some thousands" of specimens there. Such numbers at one area are not in accord with fulgurite records elsewhere, and it may be worth while examining the physical conditions about Port Macquarie in the effort to discover the reasons for this extraordinary concentration. The writer is deeply indebted to Mr. Jeff. Hill, of Raleigh, North Carolina, for an interesting set of characteristic fulgurites, several of which are shown in the plates herein.

It has been noted that they are often found near the top of the highest sandhills. But they also occur on the sandy plains of the Victorian Mallee and

of Central Australia. Several observations show that they are often formed where a tree or shrub has been "struck" by lightning, roots are said to have been found in some tubes, and chemical analysis in one case shows a considerable amount of carbonaceous matter. The question arises whether or not all sand-tube fulgurites have arisen from lightning striking a tree or shrub.

Jeff. Hill, of North Carolina, in a personal communication referring particularly to North American occurrences, writes: "One prime requisite, it appears, for the formation of fulgurite shafts is that the electrical storm cloud blow in from a body of water." This does not agree with the formation of fulgurites in Central Australia, the Libyan desert, and other places inland.

The origin of the lumen will be generally accepted as being due to rapidly-developed pressure from the expansion of heated gases. But the origin of the wings (flanges, ridges, corrugations, etc.) is more difficult, as is the origin of the flat (so-called "collapsed") tubes. The cross section of "flanges" is quite similar to the cross section of flat tubes, and "collapse" has not been suggested as the cause of the flanges. A study of the relation of the flanges to the lumen shows that they naturally arise at an angle in the lumen and that the interior glass of the lumen extends continuously up the flanges.

The writer finds himself in agreement with Merrill (ref. 7), who writes (pp. 88–89): "The fact that these (corrugations), although usually extending in a direction approximately parallel to the length of the tube, start out at any point in such an irregular manner, and occasionally at very nearly right angles to the length of the tube, seems in itself a sufficient objection to this idea (namely, rapid cooling and collapse). Is it not more probable that they are formed by the lightning following out the path of least resistance, causing the bore to be enlarged here and contracted there in accordance with the conductibility of those portions through which it passed (and the amount of moisture they contained), and that the smaller branches and wings, sometimes mere points, are lateral offshoots? The absolute contact, in some cases, of the inner walls of the wings, together with the fluidal structure extending from within outward, as noted by Wichmann, would, it seems to me, tend to prove that they are original structures, and in no way caused by a subsequent collapsing."

Dr. Lincoln La Paz, Director of the Institute of Meteoritics, Albuquerque, writes to me that although the state of New Mexico is noted for the high incidence of thunderstorms during considerable portions of the year, neither he nor Dr. Northrop, Professor of Geology, knows of any fulgurite occurrences in that State. La Paz drew under my notice a spiral fulgurite described by W. H. Hobbs from Cutler, Wisconsin (Am. Jour. Sci., vol. 8, 1899, pp. 17–20). The special interest of this lies in the fact that a spiral tendency has been

noted in several specimens figured in this paper. Hobbs describes and figures the Cutler specimen; he calls it a "perfect dextro-rotary helix". From the photograph it appears little different from a Port Macquarie specimen (S.A. Mus. T1001). The dextro-spiral character is best seen from the end, and is not easily shown on a photograph taken from the side (see Plate VIII, No. 6). Prof. Bayley has also described a fulgurite from Waterville, Maine, in which the corrugations wound about the fulgurite axis in a dextro-rotary helix. In Hobbs's paper, the suggestion is made that the earth's magnetic field may have influenced the lightning discharge. Discussing the persistent suggestion of a right-handed twist in the corrugations of fulgurites, from both the northern and the southern hemispheres, Prof. Sir Kerr Grant suggested that it may be due to the magnetic forces developed around the lightning current. This point is worthy of further enquiry and experiment.

An important object throughout these enquiries has been to note whether the evidence of these lightning-formed glassy objects lends any support to the theory that tektites may have been formed by electrical fusion. Fulgurites are of world-wide occurrence, and show the same general form and composition wherever found; their composition has minor variations according to the surrounding sands.

Tektites are not of world-wide occurrence, and show distinct variations in shape and composition within each of the six or eight known and accepted groups; they bear no relation to the rock type or the sands of the places where they are found. The evidence of the fulgurites is distinctly in opposition to the theory of a fulguritic (electrical) origin for tektites. In any case, Dr. Paneth (ref. 12) appears to have made a neat and complete answer to the exponents of a terrestrial origin for tektites.

Dr. Paneth defines meteorites as of three classes: irons, stones, and glasses. In his discussion of glass meteorites he takes us back to the days when scientific men did not believe in the occurrence of stone meteorites. He writes: "Whether we like the idea or not, as long as all theories trying to explain the occurrence of these glass pieces either as products of human manufacture or as terrestrial formations can easily be disproved, there is no alternative left but to assume that they are of extra-terrestrial origin. We may use the same argument by which in 1803 the chemist de Fourcroy tried to convince his still sceptical colleagues in the French Academy of the reality of stone meteorites: 'By eliminating the absurd or impossible one finds oneself compelled to adopt what would previously have appeared to be almost incredible.' Only the hypothesis of a celestial origin can explain for instance that millions of rounded black pieces of a siliceous glass, of an average weight of one gramme, are strewn

over the central and southern part of the whole Australian continent, thus being distributed over an area of more than two million square miles."

It may be emphasized, in conclusion, that apart from the fact that both fulgurites and tektites are naturally-occurring silica glasses, there is nothing whatever in common between them, whether we consider their chemical composition, their physical characters, their external shapes, their internal flow structures (compare these in Merrill, ref. 7, and Baker, ref. 10), their manner of occurrence, or their mode of distribution.

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REFERENCES CITED.

1. "Note on the occurrence of Fulgurites in the Sandhills at Kensington and Bondi in New South Wales: with a bibliography of fulgurites," by G. H. Knibbs, J. W. Grimshaw, and J. M. Curran. A.A.A.S., vol. vii, 1898, pp. 377–383, with one plate.
2. "A Fulgurite from Moreton Island," by T. H. Connah, *Queensland Mining Journal,* January 20, 1947, p. 20, with two figures.
3. "Contributions to the Mineralogy of Western Australia," Series VI, Note No. 7, "Lechatelierite," by E. S. Simpson, *Jour. Roy. Soc., West. Aust.,* xvii, 1930–1, pp. 145–6, with one plate.
4. Note in *Trans. Roy. Soc., S. Aust.,* by J. C. Verco, xxxi, 1907, pp. 316–7.
5. "Natural Glass from Macedon, Victoria, and its relationship to other natural glasses," by Baker and Gaskin, *Jour. of Geology,* liv, No. 2, March, 1946, with several figures.

6. Note in Journal of Researches into the Geology, etc., of various countries visited by H.M.S. Beagle, 1832–1836, published 1839. By Charles Darwin. "Fulgurites," pp. 69–71.
7. "On Fulgurites," by Geo. P. Merrill, *Proc. U.S. Nat. Mus.*, ix, 1886, pp. 83–91, with one plate and bibliography.
8. "On Fulgurites from Griqualand West," by Frank Rutley, *Mineralogical Magazine,* x, 1894, pp. 280–284, with one figure and bibliographical references.
9. "A study of the structure of Fulgurites," by Alexis A. Julien, *Jour. of Geology,* Chicago, ix, 1901, pp. 673–693, with three figures and bibliographical references.
10. "Flanges of Australites (Tektites)." By Geo. Baker, *Mem. Nat. Mus., Melb.*, No. 14, Part I, May, 1944; with three plates and several figures.
11. "The Origin of Meteorites." Halley Lecture, May, 1940. By F. A. Paneth, Clarendon Press, Oxford, p. 6.
12. "North American Tektites," by Virgil Barnes, *Univ. Texas*, Publ. 3,945, June, 1940, pp. 477–582.
13. "Australites," various papers by C. Fenner. *Nature,* cxxxii, p. 371, 1933; *Trans. Roy. Soc., S. Aust,* lviii, 1934; lix, 1935; lxii, 1938; lxiv, 1940; *B.A.A.S.,* Nottingham, 1937; *Min. Mag.,* London, xxv, 1938; *Soc. for Research on Meteorites,* Los Angeles, 1937; *A.N.Z.A.A.S.,* Canberra, 1939; "The Sky," New York, June, 1939.

Note 1.—Re limonitic fulgurites. Since writing the foregoing notes I have received a paper, published in "Rocks and Minerals," U.S.A., Sept.-Oct., 1948, pp. 802–806. The paper is entitled "A Report on unusual Limonitic forms from Van Buren County, Michigan," by Jeff Hill, of Raleigh, North Carolina. In this the author, both by his arguments and his photographs, makes out a strong case for the possibility of fulgurites being formed in limonite sands.

Note 2.—Concerning the suggested right-handed spiral of natural sandtube fulgurites, a very beautiful enlarged photograph has recently been published, giving two views of a lightning flash. In both cases the "flash" was definitely a dextro-rotary spiral in form, though the spirals were much more sharp and close than is the case in any sandtube fulgurite I have seen.

EXPLANATION OF PLATES.

Plate vii.

1. Sandtube fulgurite, Warrina, near Oodnadatta, Central Australia, Tate Museum, Adelaide University (ref. 3); unusually large.
2. Sandtube fulgurite, near Farina, Central Australia, marked "Lechatelierite, Dr. H. Basedow", Tate Museum, Adelaide University; unusually large.
3. Sandtube fulgurite, South Australia, possibly Port Noarlunga. Tate Museum, Adelaide University.
4. Sandtube fulgurite, Kensington, Sydney, New South Wales (ref. 1). Tate Museum, Adelaide University.

Plate viii.

5. Sandtube fulgurite, near Springsure, Queensland, from Queensland University collection.
6. Sandtube fulgurite, Port Macquarie, New South Wales, from Queensland University collection.
7. Sandtube fulgurite, Moore Park, Sydney, New South Wales, from Queensland University collection.

8–9. Sandtube fulgurites, Moreton Island, Queensland, from Brisbane Museum collection.

10–11. Sandtube fulgurites, small diameter with unusual ridges, Port Macquarie, from Brisbane Museum collection.

12. Sandtube fulgurite, Yeppoon, Queensland, from Brisbane Museum collection.

Plate ix.

13–17. Sandtube fulgurites, iron-stained, Bronzewing, Victorian Mallee; Fonner collection.

18–20. Sandtube fulgurites, flattish specimens, Michigan, U.S.A.; Jeff. Hill collection.

21–24. So-called limonitic fulgurites, Van Buren County, Michigan, U.S.A.; Jeff. Hill collection. 21 and 22 have a fulguritic appearance; 23 and 24 are tubular; all four are dark reddish-brown in colour.

Plate x.

25–26. Sandtube fulgurites, Nags Head County, North Carolina, U.S.A.; Jeff. Hill collection.

27–28. Sandtube fulgurites, terminal types, Rock County, Wisconsin, U.S.A.; Jeff. Hill collection.

29–30. Sandtube fulgurites, Van Buren County, Michigan, U.S.A.; Jeff. Hill collection.

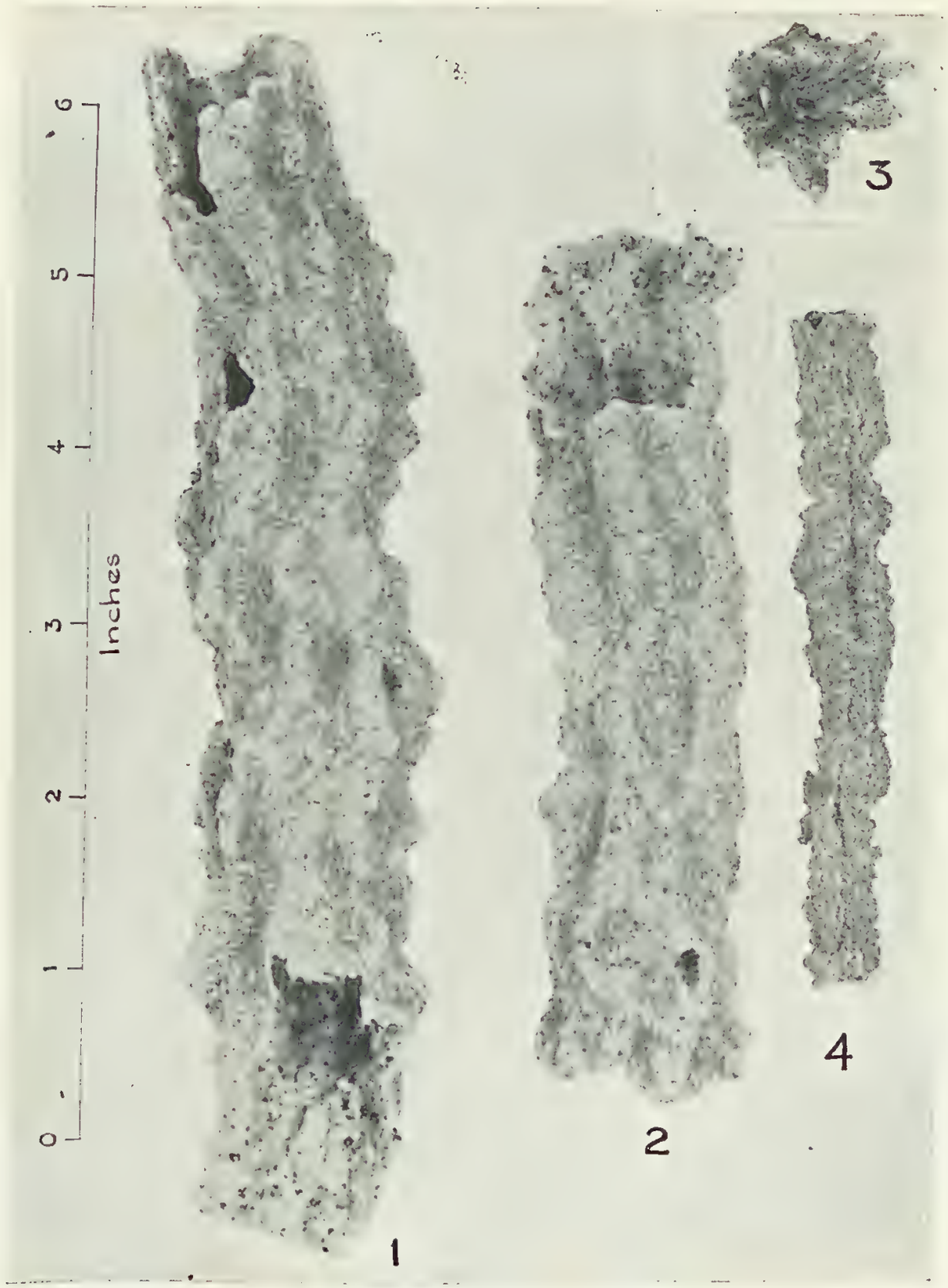
Plate xi.

33–36. Artificial sandtubes, made in Professor Sir Kerr Grant's laboratory, University of Adelaide.

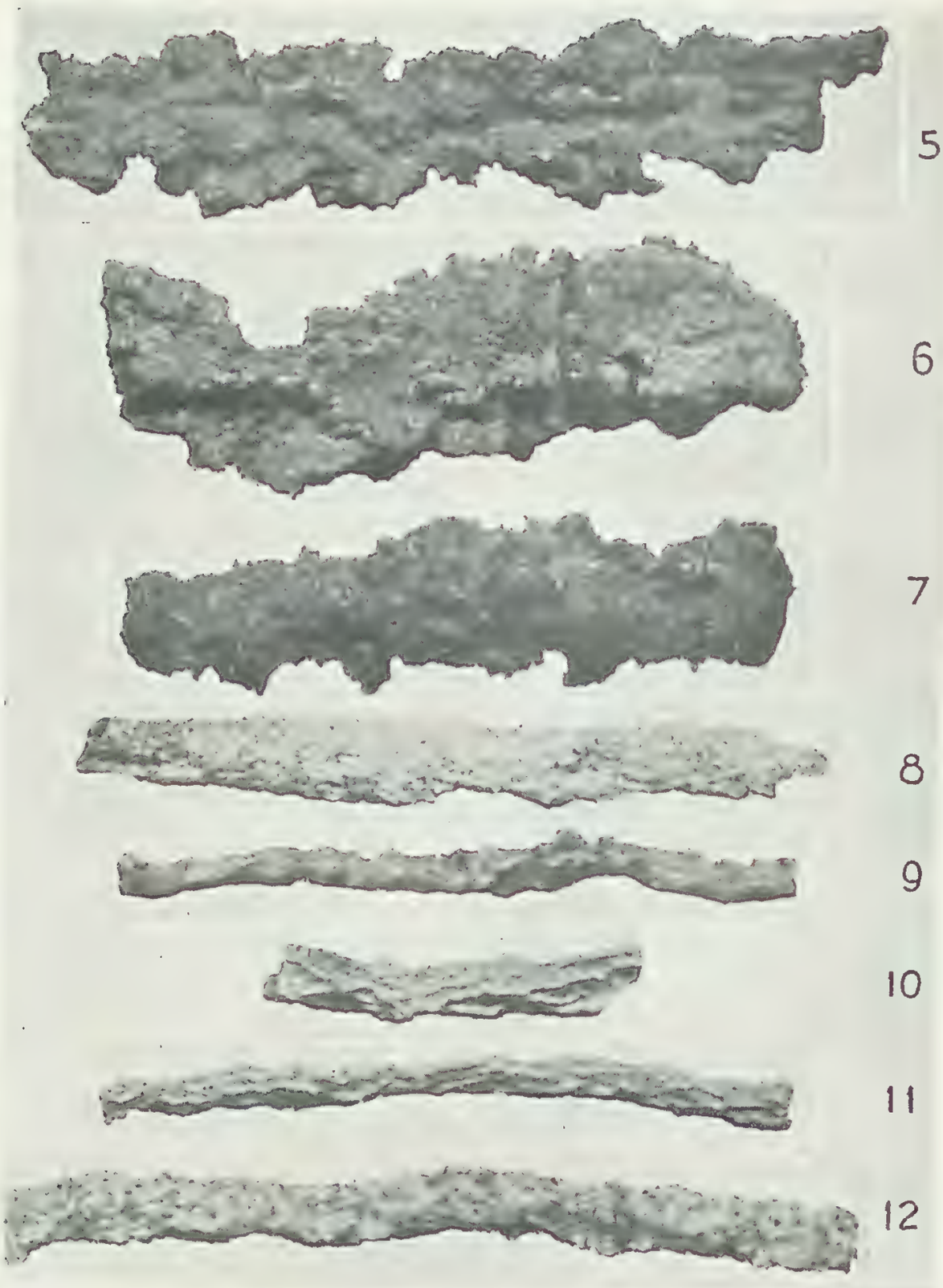
37. Small delicate four-branched tube, made in Professor Grant's laboratory, University of Adelaide.

38–39. Artificial sandtubes, due to break in transmission lines, Welshpool, Western Australia, from Professor de Courcy Clarke, University of Western Australia.

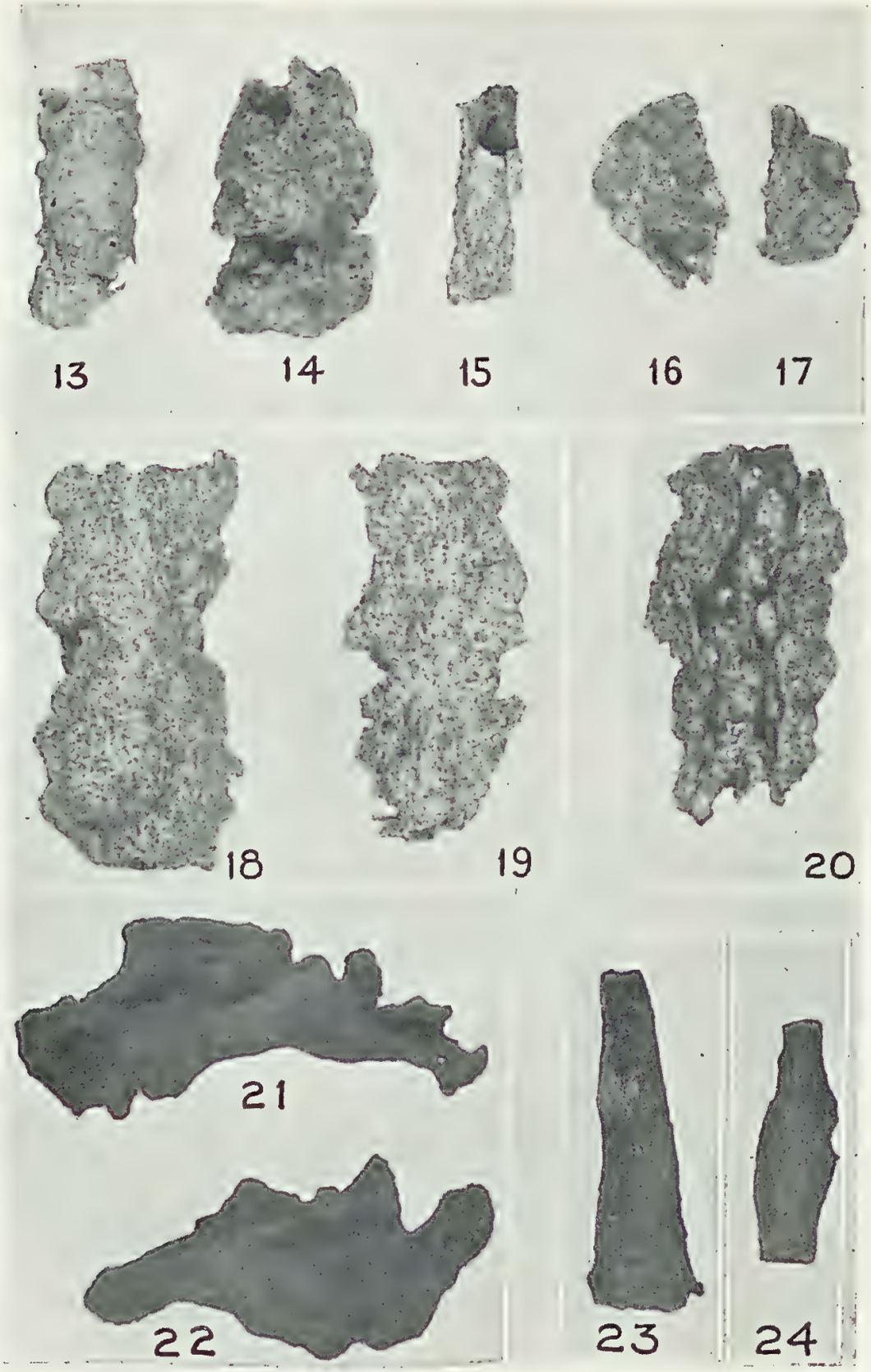
40. Large vesicular mass of silica glass, caused by shorting of electric mains, Cottesloe, Western Australia.



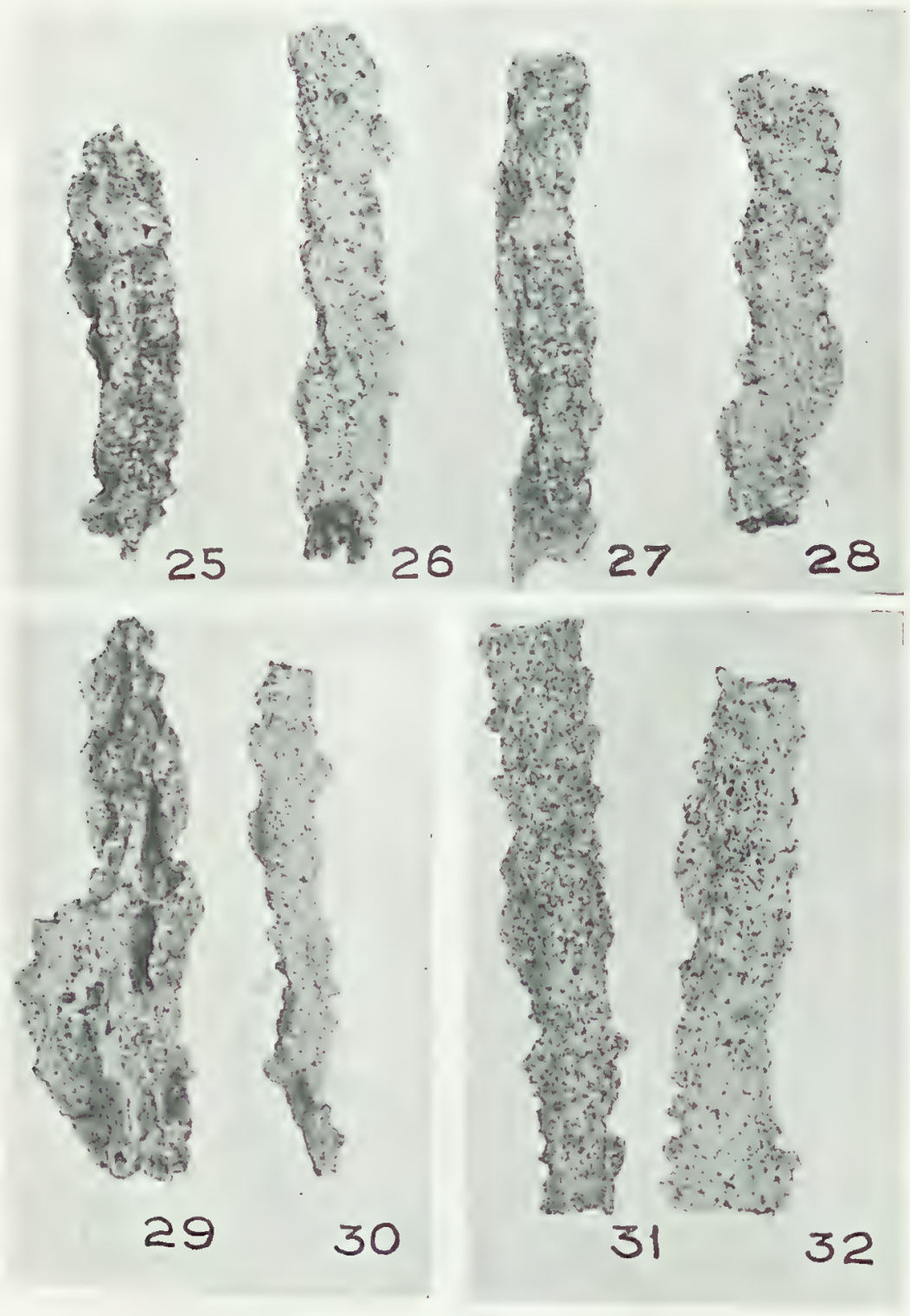
Sandtube Fulgurites, sizes as on scale.



Sandtube Fulgurites, natural size.



Sandtubes and "limonitic fulgurites", natural size.



Sandtube Fulgurites, natural size.

Experimental and accidental sandtubes, sizes as on scale.

NEW SATYRIDAE OF THE GENUS *OREIXENICA* FROM SOUTH AUSTRALIA AND NEW SOUTH WALES

TOGETHER WITH NOTES ON THE RECENT CLIMATE OF SOUTHERN AUSTRALIA

By NORMAN B. TINDALE, B.Sc., South Australian Museum.

Plate xii.

A new form of the Eastern Australian Satyrid butterfly genus *Oreixenica*, related to *O. kershawi* Miskin 1876, was taken during February, 1948, in a coastal swamp west of Millicent in the South-East of South Australia.

Only a year previously *Tisiphone abeona* Donovan 1805 was described from Lake Edward (Tindale, 1947 (1)). The presence of *Tisiphone*, relatively sensitive indicator of a humid climate, had suggested the possibility of the occurrence of other moisture-loving species of butterflies in the swampy country of the South-East, nevertheless to find another so soon was an agreeable surprise.

Previously known forms of the *Oreixenica kershawi* species complex were:

Oreixenica kershawi kershawi Miskin 1876. Victoria: Mount St. Bernard, Mt. Erica, Wandin, Toora, Fern Tree Gully, the Dandenong Range, Belgrave and Lorne, flying from January to early April. (Plate xii, fig. 1–4).

Oreixenica kershawi ella Olliff 1888. New South Wales: Barrington Tops, above 3,000 ft., from December to early February. (Plate xii, fig. 13–16).

Examination of the South Australian Museum series revealed the presence of a third race, hitherto undescribed, from the Federal Capital Territory. There are thus four races to be recognized. These four show considerable differences, one from the other; at least two, including the South Australian one, might almost be regarded as having attained specific status, save that all four inhabit separate geographic areas, occupy similar ecological niches, and suggest thereby that they have been derived from a single species, members of which had become isolated in four separate geographic areas by the development of climatic barriers. The environments are not everywhere identical. It will be noticed that Waterhouse (1932) considered *O. kershawi* was always found where the Australian beech (*Nothofagus*) is growing. This is certainly not the case where the new South Australian form is concerned. The two new races extend the range of the species without providing any closer links between the forms.

The new race from South Australia is rather distinctive since, so far as may be judged from a single pair, it is the smallest yet known; the form from the Federal Capital Territory is very large.

OREIXENICA KERSHAWI KANUNDA subsp. nov.

Plate xii, Fig. 5–8.

♀ Wings above black with golden-brown spots and bands; forewings with four principal spots and several smaller ones surrounding a sub-quadrate black area at the forking of veins M_3 and Cu_1a. There are four spots along the costa of which the subapical one is divided into three conjoined spots by darker veins; there is a small, black, virtually blind eyespot and four small narrow subterminal marks forming a linear series. The hindwing bears a series of spots forming incipient bands pointed towards a large tornal ocellus which has a small white centre; the principal band, which commences on costa at one-half, is distinctly broken at the cell. Forewings beneath dull black with pale golden-brown and richer brown markings, patterned somewhat as above, but becoming paler towards apex of wings; the subterminal series of brown spots found above replaced by an outwardly concave and rather conspicuous subterminal white fascia. Hindwings beneath rich brown with silvery-white bands pointed to a large ocellus near hinder angle; a smaller second ocellus near apex; the principal silvery-white band from costa at one-half to ocellus is interrupted at the apex of the cell. Expanse 35 mm.

♂ Similar to female, but smaller, and with traces of a sex brand on the forewing above, extending from near middle of hind margin to the vicinity of the apex of the cell. Expanse 33 mm.

Loc. South Australia: Canunda Swamp, 8 miles west of Millicent (holotype a female, and allotype male, registered number I. 18963, in South Australian Museum), taken 23rd February, 1948, by N. B. Tindale. Victoria: Dartmoor, two males, taken January 1940, by F. Erasmus Wilson; now in collections of M. W. Mules and F. E. Wilson. The chosen name is based on an aboriginal word.

Canunda Swamp is situated about a mile south-west from the ruins of the old homestead on Canunda Station and immediately behind the innermost of the high Recent sand dune ridges which range along the present coastline to a depth of about two miles from the sea coast.

The first example of the butterfly was seen, and lost, on 21st February. It was a worn female, which was flying, and alighting, in dense ti-tree and sword-grass thickets. A second visit, two days later, was more successful. Four hours of work, beating and quartering the narrow swamp area over a distance of a quarter of a mile, brought to the net two examples. One was a slightly worn

male taken at about 10 a.m., and the other a freshly emerged female captured just before noon. The insect may be very local, since both chanced to be taken within five yards of the place of original sighting of the species. The weather was dull, inclining to rain, but there were glints of sunshine. The butterflies sluggishly flew at about waist level among head high tangles of a purple-flowered ti-tree, probably *Melaleuca squamea,* and sword grass (*Gahnia* cf. *trifida*). They settled on the tips of ti-tree branches with their wings partly open and oriented to catch a maximum of sunshine. The ground underfoot was wet and covered with intensely green native grasses. The presence of larval trombiculid mites made collecting conditions uncomfortable.

OREIXENICA KERSHAWI PHRYNE subsp. nov.

Plate xii, Fig. 9–12.

♂ Wings above black with pale golden-brown spots and bands; forewings with five principal spots forming a rough circle around a black area at the forking of veins M_3 and Cu_1a; this black area is traversed by a faint oblique line of sex scales; there are four spots along the costa, of which the subapical one is the smallest and divided by the veins into three parts, the next one is also divided into two by a vein, the costal and smaller portion surrounded by a narrow golden-brown ring and touching a rather rectangular pale brown spot; there are three indistinct subterminal linear marks and traces of a fourth. Hindwing with a series of spots forming incipient bands pointed towards a large white-centred tornal ocellus; the principal band is of medium width, forming a single irregular fascia which is strongly constricted about the middle of its length. Forewings beneath dark brown with golden-brown markings, which, near the costa, become almost white; a white subterminal fascia from near apex to near hind margin, which is black. Hindwings beneath pale brown with dull silvery-white bands pointing to a medium-sized ocellus near hinder angle; a second smaller ocellus near apex; the principal white band from costa at one-half to ocellus is wide; it is constricted only at the cell. Expanse 44 mm.

Loc. New South Wales: Lee Spring, Federal Capital Territory (holotype a male and paratype male, marked I. 18964 in South Australian Museum), taken 19th February, 1938, by Mr. D. F. Waterhouse; also a third specimen taken 26th February, 1938, in collection of Mr. M. W. Mules.

This form is distinctive owing to its large size, the pale brown colour of the hindwings beneath, and the form of the median fascia of the hindwings, above and below. The more obvious differences between the forms of *O. kershawi* may be set out as follows:

	kershawi	*kanunda*	*phryne*	*ella*
Expanse of male	35–42 mm.	33 mm.	43–44 mm.	38–43 mm.
Expanse of female	38–41 mm.	35 mm.	—	37–40 mm.
Colour of wing markings above	golden-brown	golden-brown	pale golden-brown	orange-brown
Colour of hindwings beneath	dark chocolate-brown	rich brown	pale brown	dull brown
Form of brown wing-markings above	separate and small	conjoined and large	separate and medium	conjoined and medium
Width of median fascia on hindwing above	narrow	medium	medium	wide
Form of median fascia above	separated into 4–5 conjoined spots	two bars conjoined in middle	single bar strongly constricted in middle	single bar constricted in middle
Width of silvery-white median fascia on hindwing beneath	relatively narrow	wide	wide	very wide
Form of median fascia on hindwing beneath	divided in two at cell	strongly constricted at cell	constricted at cell	not markedly constricted at cell

TISIPHONE ABEONA ANTONI Tindale, 1947.

Since this race was described from Lake Edward and the Grampians, Dr. R. V. Southcott, whose initials were, in the original paper, inadvertently misprinted as A.V.S., has returned to his former collecting spot at McKenzie Creek in the Grampian Mountains. Between 31st December and 4th January, 1948, he took a fresh series of seven males and five females. This useful collection confirms the distinctive character of the western race of *Tisiphone abeona*. Mr. F. E. Wilson has written to say that he took specimens of the species at Dartmoor in 1939.

RECENT CLIMATE OF SOUTHERN AUSTRALIA IN THE LIGHT OF THE DISCOVERY OF *OREIXENICA K. KANUNDA* TINDALE, 1948.

In reporting the discovery of the butterfly *Tisiphone abeona antoni* (Tindale, 1947 (1), p. 616) at Lake Edward, some inferences were made on the climate of Recent time in the South-East of South Australia.

It was concluded that the distribution of races of *Tisiphone* seemed to be controlled by relatively strict moisture and temperature requirements and that at Lake Edward in South Australia, at Dartmoor in Victoria, and in the Grampian Mountains, Victoria, the climatic conditions were suited to it, but that any marked deterioration in climate in the direction of greater aridity would have been likely to have caused the butterfly to become extinct.

The presence of a buffer area represented by the Grampian Mountain massif might be considered to have afforded *Tisiphone a. antoni* some measure of protection against minor fluctuations in climate even at the outlying habitat of Lake Edward, in view of a possibility that recolonization of the restricted lake area might be possible from this climatically more varied area. This did not alter the general inferences to be drawn from the presence of a separate race of *Tisiphone* in the Grampians, Dartmoor and Lake Edward areas, separated from *T. a. albifascia* by almost the whole width of Western Victoria.

It was inferred that, following very moist and cool conditions leading to colonization of the whole of Western Victoria by *T. abeona*, the past history of the area, over a period of time sufficiently long to have permitted the formation of a distinctive race, was one of relatively cool moist conditions. These conditions might be tending to become somewhat drier and less favourable for *Tisiphone*, since its habitable niche as a race appeared to have contracted to a series of smaller refuge areas within the larger area of its distribution.

The occurrence of an additional moisture-loving species in the South-East of South Australia, *Oreixenica k. kanunda*, appears to afford a further measure of confirmation for such inferences, indicating that the immediate past history

of this part of Southern Australia may have been one of transition from a relatively cool moist climate to one somewhat warmer and drier.

The period of optimum climatic conditions apparently was sufficiently long to have permitted the spread of *O. kershawi* from the Eastern Coast. After the Western area was isolated, a sufficient time elapsed to permit the development of particularly well-defined subspecific differences between the newly isolated South Australian and the Eastern Victorian forms. That *O. kershawi* has a restricted tolerance to climatic variation is shown by its occurrence in the race *ella* only at elevations above 3,000 feet at the northern limit of the reported range of the species; in the race *kershawi* it occurs on mountains at medium elevations (about 500 ft.–1,500 ft.) in Eastern Victoria, and down to sea level, principally at Lorne, in a cool and humid part of Southern Victoria. It has not been reported in the drier districts of Western Victoria. Mr. F. E. Wilson took two males which are very close to the type specimens, and clearly establish this western race. It is probable that like *Tisiphone,* the butterfly will be found in the Grampians and perhaps in suitable swampy areas near Cape Bridgewater and Portland.

The coastal swamps of the Millicent district and the river valley at Dartmoor provide a refuge which seemingly has enabled this Satyrid to maintain an existence even after the suggested decline in its climatic optimum. It may be noted that the specimens are the smallest of the species so far reported. Before the artificial draining of the large Millicent swamps in the latter part of last century, its distribution may have been somewhat more widespread than at present. It seems in any case to be a relict form, cut off from its eastern relatives and left over from a previously somewhat more favourable climatic era in South Australia.

It is of further interest to note that Burns (1947) described from Dartmoor a race, *wilsoni* of *Heteronympha cordace,* which represents yet another moist climate Satyrid butterfly. The parent race has a fairly wide distribution in the south-eastern parts of Australia and Tasmania. The Dartmoor form is distinctive.

Zeuner (1943) has, after studying the evolution of *Troides* and its allies during the Pleistocene, concluded that in the Malayan and Australian regions, as in Europe, "the rate of evolution of a taxonomic species . . . . is roughly the same as in Europe, i.e. about equal to the duration of the Pleistocene". Development of fourteen of the most recent Present day subspecies of *Troides* he demonstrated to have occurred between the end of the Last Glaciation (Würm 3) and the Present; other more clearly defined subspecies were older, dating probably from the Upper Pleistocene. According to Ford (1945, p.321)

45 per cent. of Pleistocene (Pre-Würm glacial) arrivals in the British Islands had formed subspecies, whereas only 10 per cent. of Holocene arrivals had done so, and these were very simple changes. On an average he considered the length of time since the Last Glaciation rather short for butterflies to have formed subspecies in the British Isles.

If these and other similar deductions as to time factor have validity, it is possible to consider that the formation of the rather distinctive subspecies *Oreixenica k. kanunda* as well as *Tisiphone a. antoni* and *Heteronympha c. wilsoni* may have required at least the whole interval between the latest phase of the Last Glaciation (Würm 3) and the Present. The extensions of their habitat to South Australia may have been events of the Last Glaciation and their subspecific differentiation commenced with the onset of Post-glacial times. In such a case the climate has at no time since been sufficiently arid to cause any one of them to become extinct, but on the contrary it has remained relatively moist until, at a late stage, it may have declined to about its present degree of aridity.

These inferences as to climate and those by Tindale (1947) appear to be in direct contradiction to conclusions reached by Crocker (1941, 1946) on the basis of soil data, and by Crocker and Wood (1947) on the basis of the development of plant communities in South Australia.

According to the last-named authors, South Australia is at present in a stage of recovery from a catastrophic period which is termed the "Great Arid". This was an age of maximum aridity which has had profound effects on the Southern Australian flora. Their discussion (1947, p. 129) seems to imply the virtually complete extinction of Pleistocene floral assemblages either about 4,000–6,000 years ago or (as a probable maximum) no more than 10,000 years ago. They infer the presence in late Recent times of vast, virtually bare areas, especially in the regions which are still arid. Present day communities thus are chiefly the results of Late Recent recolonization.

In view of apparently contradictory results, present day distributions of some plants quoted as evidence for the "Great Arid" by Crocker and Wood may be examined with profit.

Although a considerable amount of useful evidence has been brought together by them, some of it may be qualified. Other parts of it are subject to alternative explanations.

Acacia peuce, Livistona Mariae and *Macrozamia Macdonnelli* have such limited present day distributions that where they linger, any great degree of aridity over and above that prevailing at present would have entirely removed them. If rendered extinct there could not have been any re-entry unless conditions had been far more favourable than at present.

In the case of *Macrozamia Macdonnelli,* Crocker and Wood admit as necessary a theory of a change from a wet to a dry climate to account for its occurrence in Central Australia.

Present day areas of survival of *Acacia peuce* imply that there was a prior period when its distribution was relatively continuous. Now only two or three limited areas situated widely apart are sufficiently favourable for the growth of small populations. These areas are so relatively uniform as to altitude and general climate, that they might almost serve as a guarantee that since the pluvial conditions which assisted them to their present habitats, there has been no intervening drastic arid phase, over and above that being experienced at present. In the belt between 25° and 26° South Latitude therefore, conditions since a long pluvial episode of the Last Glaciation probably have not been over any long period much less favourable than at present, and it may be that the climate is only now tending towards an arid phase from this formerly more pluvial one.

The distribution of *Eucalyptus cladocalyx* in South Australia also may be illuminating. According to Crocker (1946), this tree may be verging towards the lower limit of its edapho-climatic range, and on Eyre Peninsula it is particularly depauperate. Could it have withstood any further great degree of aridity without extinction? Perhaps as in the moisture-loving *Tisiphone, Oreixenica* and *Heteronympha* referred to in an earlier part of this paper, it has only recently been isolated by onset of less favourable conditions. Sub-specific differences between the forms present on the three areas about the South Australian gulfs are not noticed by Crocker and Wood. It might be assumed that separation of the three areas is a relatively late event in the history of *E. cladocalyx.* Like the butterfly *Tisiphone,* the species has lately been isolated within its larger area of isolation by a current phase of deterioration in climate. It would be an interesting and perhaps profitable exercise to attempt to determine what degree of amelioration of climate would be sufficient to again link together these three isolation areas, and further, what conditions would be necessary to join the Gulf region of South Australia to the main South-Eastern Australian areas from which the parent form seems to have come.

Situations similar to those encountered in the case of *E. cladocalyx* appear to govern the present distribution of *E. macrorryncha* and *E. hemiphloia.*

The *Eucalyptus Baxteri* situation in the Upper South East has been quoted by Crocker and Wood as evidence for a recent northward extension of its range following amelioration of climate. The trees at the northern limit are reduced to depauperate shrubs. They develop into trees only as one goes south into country of higher rainfall. The point of view is possible that this is no vigorous

tree, successfully invading new territory as it becomes available with relaxation of climatic stress, but that rather it is a not insignificant example of a relict form, struggling to maintain itself in a deteriorating climate. Its widespread occurrence as a depauperate shrub and the possible absence of evidence of active advance may tend to support the latter conclusion.

It is not intended to bring up the wider issues of the problem of aridity in South and Central Australia, raised by Crocker and Wood, since these might better be separately discussed. Suffice to say that dune systems south of the Mann Range in the far north-west of South Australia, examined by the present writer, also ones seen near Birdsville, Queensland, appear to be actively developing under the climatic conditions of to-day. It may not be necessary to appeal to a "Great Arid" period, now vanished, to account for these dune systems.

Some of the data used for establishing the existence of the "Great Arid", and for a Recent wet period following it, by Crocker (1941, 1946) and summarized by Crocker and Wood (1947) may be of a composite nature, referring to climatic episodes far-sundered in time.

Two instances may be cited; they comprise two of the principal listed items of evidence for Crocker's post-"Great Arid" improvement in climate.

The *Notopala wanjakalda* horizon at Burdett in the Lower Murray Valley was re-examined by Tindale (1947, p. 635). The shells at this site were shown to be *in situ* in a section of Pleistocene lagoonal beds at an elevation of 65 ft. above present sea level, and therefore to be identified in age as possibly Monastirian I.

The siliceous sands of the South-East, thought by Crocker to indicate the same post-"Great Arid" period, are present on the surfaces of the Woakwine Range (or 25 foot terrace). These siliceous sands are residuals, derived by leaching of the predominantly limesand from surface layers of Woakwine Range dunes. They are therefore post-Monastirian II. Similar sands occur on each of the earlier marine terraces of the area. Due allowance being made for wind drift, they are indicative only of pluvial conditions at times posterior to the period of formation of the particular dune range from which they are derived and upon which they may occur.

Monastirian I and Monastirian II represent interglacial stages in the Upper Pleistocene. Monastirian I is placed by Zeuner (1945) as 150,000 years ago, while Monastirian II at latest is placed at 65,000 years ago, and may be older.

It thus would appear that some of the changes observed by Crocker and Wood may have taken a far greater period of time than considered necessary by them, and it would seem that at least an appreciable portion of the Upper Pleistocene may be involved.

Some of the data used as evidence for a "Great Arid" should perhaps be re-examined and further study made to differentiate between items of different ages in the Upper Pleistocene. Despite the possible break-down in evidence for Crocker's "Great Arid" as a Post-Glacial event, there is evidence to show that there was a Recent period of high sea levels, the Post-Glacial High Terrace (5–10 ft.), during which a slightly warmer climate than at present may have prevailed in South Australia. Evidence that this was a period so dry as to be the "Great Arid" postulated by Crocker, has yet to be marshalled.

It will be as well therefore to examine some of the information available about the climates of the Upper Pleistocene and Recent time.

The latest event of Pleistocene time was a glacial period (Würm 3) from which the world is now in a stage of recovery. The effects of such a recovery on the climates near the poles are relatively clear. It is well understood that variations of climate observable in one latitude may be diametrically opposite to those occurring simultaneously in another; when tracing the effects of glacial and interglacial conditions from high latitudes to low ones, particular caution is necessary.

Attempts have been made to study Pleistocene and Recent climates in middle latitudes. Zeuner (1945, p. 221), for example, developed curves of summer radiation affecting different latitudes in the later half of the Pleistocene and the Recent. One such curve gives data for 25° South Latitude. He applied this information to a study of South Africa. Here, during the Last (Würm) Glaciation, summer radiation was low and pluvial conditions prevailed. At 25° South Latitude summer radiation since the end of Würm 3 has steadily increased. In the past 10,000 years the caloric equator has been moving away from the south. Starting with the pluvial conditions of the beginning of Recent time in South Africa, there has been increasing desiccation. According to his interpretation the movement of the caloric equator northward came to a standstill about 1,200 A.D., and both radiation and caloric equator curves are beginning to return from a minor maximum of that date, suggesting a possible slight climatic amelioration at middle latitudes, only in the past few hundred years.

It will be seen from the trend of the evidence referred to earlier that conditions similar to those prevailing in South Africa may have occurred in South Central Australia during the time between the end of the Pleistocene and the Present.

Strongest support for a relatively warm and dry interval of about 2,000 years' duration, and dated between 4,000 and 6,000 years ago, may come from pollen profile evidence in Northern Europe. Since warmer, drier climates in

N. Europe bring on an amelioration of the relatively severe climates experienced there, this period is sometimes given the somewhat misleading title of a "climatic optimum". According to Flint (1947) evidence for one such Postglacial interval is clearly established in Scandinavia and in the Alps, where the snowline may have been as much as 1,000 feet higher than to-day. It has been calculated that in North America at this time average summer temperatures may have been 1·5° C. above the Present and the duration of summer may have been about 15 days longer than to-day.

This degree of increase of warmth compares with an estimated 10° C. range over the whole gamut from a glacial to an interglacial climate.

On the North American continent, the Postglacial warm period produced changes which were most noticeable between 40°–50° N. latitude and least evident between 30° and 40°. In the latter belt the "climatic optimum" may have been somewhat drier without any marked increase in temperature.

The "Postglacial optimum", by several authors, as summarized by Stearns (1945) is equated with the temporary high shorelines between 5 and 10 feet above present sea level, which are evident in most parts of the world.

Possible indications are available for a progressive decline in rainfall in the Murray Valley, South Australia (between 34° and 35° South Latitude), during a part of Recent time. This evidence may reflect events in the whole Murray-Darling Basin, rather than actual local rainfall. The indications were found during the excavation of Devon Downs Rockshelter by Hale and Tindale (1930, p. 214). The indicator took the form of a changing ratio of fresh-to-brackish-water shells in stratified deposits extending from a depth of 6 metres (21 feet). These deposits revealed a change from a freshwater-shell-dominant regime to a brackish-water-shell dominant one. This progressive deterioration may have taken place over a considerable period in Recent time, between an aboriginal cultural period called *Pirrian* and the *Murundian* cultural period of the present day. The time interval *Pirrian-Present* has not yet been established on the absolute scale. It may have involved at least several thousand years, although it almost certainly did not go back beyond the period of Post-Glacial High (10 ft. terrace), since it has been shown by Tindale (1937, p. 52) that at Fulham, South Australia, a Pirrian horizon lies above marine beds identified as of this terrace. During the passage of this interval, however, at least one minor faunal change has taken place, namely the extinction, on the Australian mainland, of the Tasmanian Devil (*Sarcophilus*).

Consideration of some of the above data therefore may lead to the conclusion that as a Post-Glacial phenomenon the "Great Arid" hypothesis of Crocker, in its present form, should be abandoned. The indications on which it was based

may be far older than appear at first sight, belonging either to Monastirian II or if the situation be more complex than as sketched by Crocker and Wood, may date in part to Monastirian II and in part to Monastirian I, during both of which there seem to have been arid periods of long duration. It is more than probable also that periods of aridity during still earlier inter-glacials have had profound effects on Australia and its fauna and flora.

SUMMARY.

A new race, *kanunda,* of the Satyrid butterfly, *Oreixenica kershawi,* is described from the Millicent district in the South-East of South Australia, together with another form, *phryne,* from the Federal Capital Territory.

On the basis of the occurrence of this humid climate requiring insect, and the other evidence (Tindale, 1947 (1)), it is suggested that the climate of Post-Pleistocene times in Southern Australia has been slowly deteriorating from one of pluvial conditions. The "Great Arid" hypothesis for this period, suggested by Crocker (1941) and discussed recently by Crocker and Wood (1947), is thought to be untenable.

REFERENCES CITED.

Burns, A. N. (1947) : *Mem. Nat. Mus., Victoria,* Melbourne, xv, pp. 86–102.

Crocker, R. L. (1941) : *Trans. Roy. Soc., S. Aust.,* Adelaide, lxv, pp. 103–107.

Crocker, R. L. (1946) : *C.S.I.R. Bull.* (Aust.), 193.

Crocker, R. L., and Wood, J. G. (1947) : *Trans. Roy. Soc., S. Aust.,* Adelaide, lxxi, pp. 91–136.

Flint, R. F. (1947) : Glacial geology and the Pleistocene epoch, New York, pp. 1–589 (Bibliography).

Ford, E. B. (1945) : Butterflies, London.

Hale, H. M. and Tindale, N. B. (1930) : *Rec. S. Aust. Mus.,* Adelaide, iv, pp. 145–218.

Miskin, W. H. (1876) : *Trans. Ent. Soc.,* London, p. 452.

Olliff, A. S. (1888) : *Proc. Linn. Soc., N. S. Wales,* Sydney, ii (1887), pp. 976–977.

Stearns, H. T. (1945) : *Bull. Geol. Soc. Amer.* lvi, pp. 1,071–1,078.

Tindale, N. B. (1947) (1) : *Rec. S. Aust. Mus.,* Adelaide, viii, pp. 613–618.

Tindale, N. B. (1947) (2) : *Rec. S. Aust. Mus.,* Adelaide, viii, pp. 619–652 (Bibliography).

Waterhouse, G. A. (1932) : *What Butterfly is that?* Sydney.

Zeuner, F. E. (1943) : *Trans. Zool. Soc.,* London, xxv, pp. 107–184.

Zeuner, F. E. (1945) : Pleistocene Period, *Ray Society,* London, cxxx, pp. 1–322 (Bibliography).

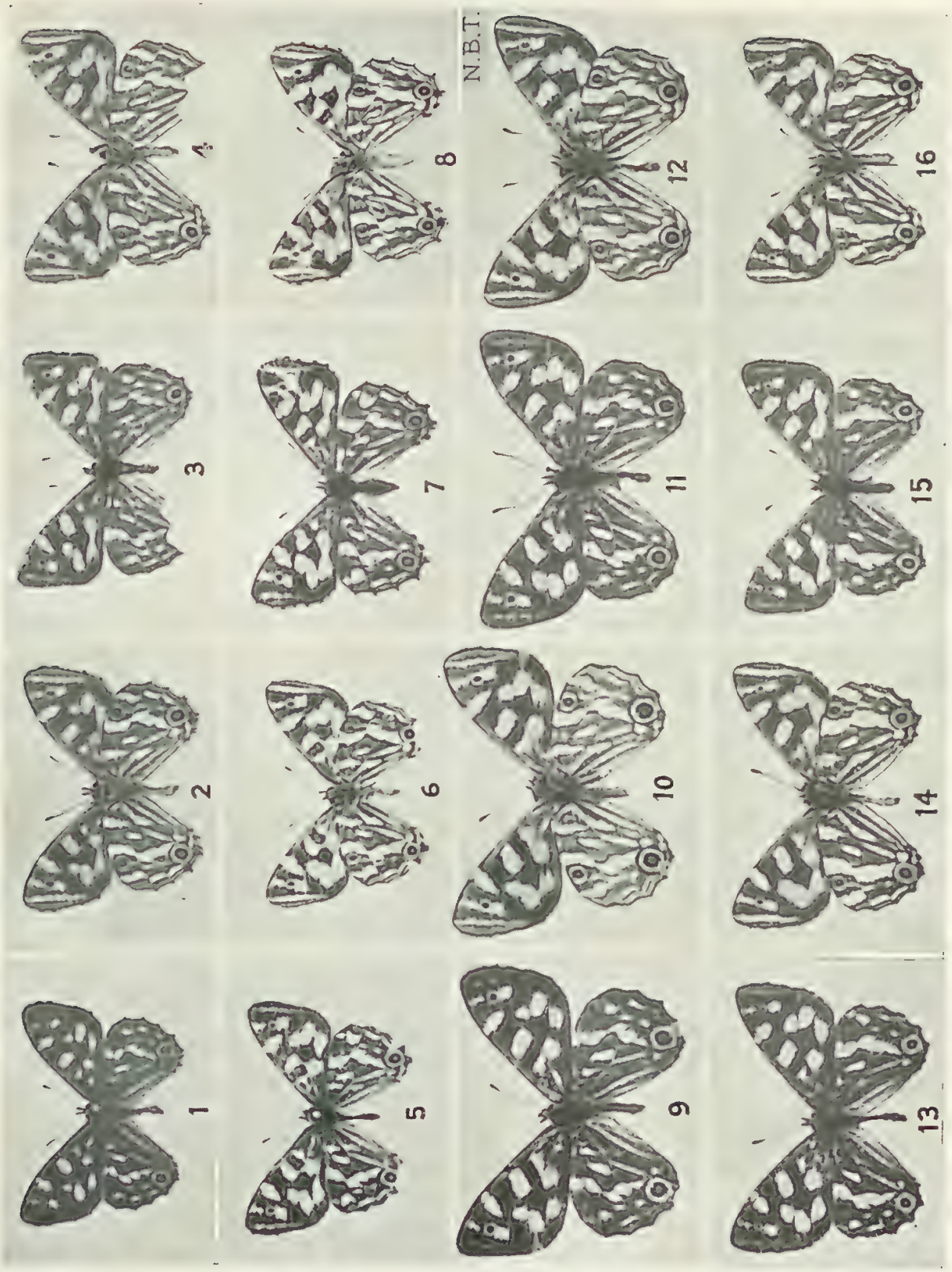
EXPLANATION OF PLATE XII.

Fig. 1–4. *Oreixenica k. kershawi* Miskin. Fig. 1–2, male, Mt. Erica, Victoria, upper and under sides. Fig. 3–4, female, Fern Tree Gully, Victoria, upper and under sides; slightly under natural size.

Fig. 5–8. *Oreixenica k. kanunda* subsp. nov. Fig. 5–6, allotype male, Canunda, S.A., upper and under sides. Fig. 7–8, holotype female, Canunda, S.A., upper and under sides; natural size.

Fig. 9–12. *Oreixenica k. phryne* subsp. nov. Fig. 9–10, paratype male, Lee Spring, F.C.T., upper and under sides. Fig. 11–12, holotype male, Lee Spring, F.C.T., upper and under sides; natural size.

Fig. 13–16. *Oreixenica k. ella* Olliff. Fig. 13–14, male, Barrington Tops, N.S.W., upper and under sides. Fig. 15–16, female, Barrington Tops, N.S.W., upper and under sides; natural size.



Races of Oreixeniea kershawi Miskin.

LARGE BIFACE IMPLEMENTS FROM MORNINGTON ISLAND, QUEENSLAND AND FROM SOUTH WESTERN AUSTRALIA

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Fig. 1–16.

INTRODUCTION.

A PATINATED biface flint implement was found by Mr. R. Randall near Scaddan, Western Australia, and presented to the Western Australian Museum at Perth. By courtesy of the Director (Mr. L. Glauert) of the Museum this remarkable specimen has been studied.

Roth (1904) described stone picks or "oyster stones" from the Wellesley Group in the Gulf of Carpentaria. Additional information was obtained about the manner of use of these implements when, in October, 1938, the present writer found three Lardil ['Lardi:l] tribesmen of Mornington Island, who were serving sentences at Palm Island for the murder on their island of a white man.

MODES OF USE OF STONE PICKS FROM MORNINGTON ISLAND.

Mornington Island, known to the natives as Kunana ['Kun:ena] is, with Forsyth Island, the home of the Lardil natives. The three Lardil informants met at Palm Island were quite familiar with stone picks of the type described by Roth and readily recognized his illustrations. According to them such stone picks were still in use on Mornington Island. They were known as *mariwa* ['mari:wa] or ['mari:we], and served as cutting, chopping and digging implements. They were used as picks in the gathering of oysters by both men and women, and by women in the sharpening of digging sticks, after the end of the implement had been prepared by charring it in a fire. They were much used by women in digging holes and in chopping out obstructing tree roots encountered when burrowing for native yams and tubers.

Asked to make demonstration examples the Lardil men said no suitable stone was available on Palm Island, but picking up sundry pieces of beach waste, one of them demonstrated various methods of using a *mariwa*.

Two principal methods were shown for holding and using the implement. The first employs what may be called the "cutting hold". This is illustrated, using an actual Mornington Island *mariwa* in Fig. 1. In the cutting grip a stone is held in the palm of the hand, its narrow end directed towards the

body of the user. The index and middle fingers pass over the broad end of the stone, which is then gripped between the thumb and the third and little fingers. The wooden object to be cut, if small, may be held either in the left hand with the portion to be cut directed to the left and cushioned on the palm of the left hand or, if larger or long, may be pinned to the ground by the right foot and the portion to be cut rested upon the fleshy part of the opposite or left thigh, or on the left hand. When seated on the ground with the legs flexed, the sole and heel of the upturned left foot may provide a convenient work bench for such cutting operations.

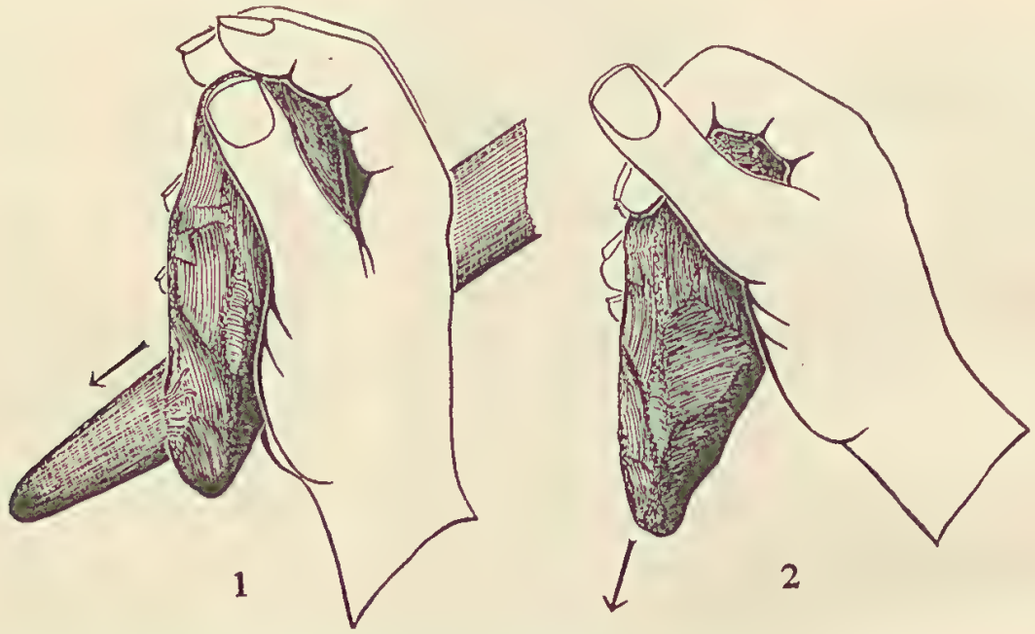


Fig. 1–2. Methods of holding a *mariwa* on Mornington Island. Fig. 1. The cutting hold. Fig. 2. The hold used in digging. Specimen A.31331 (× ⅓).

Cutting blows are in general directed across the front of the body in a slightly downward direction towards the left. The lower arm rotates on the upper, which appears scarcely, if at all, to move outwards from the body until at the moment of impact of stone against work. The motion is free and the cutting blows appear effective, being placed with a considerable degree of control. The stone in use is cushioned in the palm of the hand, the cutting margin opposite to that in use at the moment lying obliquely across the hand in the natural fold of the palm.

In a second method of using, what may be termed the "digging" or "pick hold" is employed (Fig. 2). The index and middle fingers lie over the top of the stone, while the flat faces are gripped between the base of the thumb opposed to the third and little fingers. A digging or picking action results from bringing the hand from the right side of the body towards the midline, in a somewhat

downward direction. This basic movement is, of course, readily adjustable to a variety of circumstances and enables the concentration of considerable picking efforts in circumscribed spaces or holes such as are dug when gathering yams and other roots.

Observation of the actions of cutting with several different pieces of stone made it apparent that cutting blows were made by striking the work in such a direction that a line drawn from the impact point in the direction from which the blow had come, would pass through, or very close to the centre of gravity, not of the stone itself, but of the combined masses of the implement and the hand of the user. The exact details of the mechanics of this have not been considered, but from observations it became evident that an adjustment of the cutting impact point towards the wider end of the stone was compensated for by allowing part of the wider end of the stone to be free of, and project beyond, the tips of the index and middle fingers. A movement of the cutting point in the opposite directions towards the smaller end necessitated the greater embracement of the top of the stone by the hand, culminating, at the limit, in the "digging" or "pick hold". Even in the "digging hold" the direction of the blow is, as is shown in Fig. 2, not quite in the midline of the stone, since as in the case of the cutting grip, it tends rather to be adjusted to the centre of gravity of the combined masses of the stone and of the hand that supports it.

DESCRIPTION OF THE STONE PICKS.

Roth's description (1901, p. 23, fig. 144–149) of the actual implements he collected is brief and may be quoted for reference at this point, since, although his own direct observations are in general confirmed, other details are either contradicted or should perhaps be modified in the light of present-day knowledge. He wrote:

"The picks or oyster stones of Bentinck, Mornington and Forsyth Islands, in the Wellesley Group, are formed of pieces of quartzite ('billy') jasper, or quartzite with jasper in part, chipped fairly carefully to a point, but the actual manufacture of which was not observed. They are more or less pyramidal, measuring up to $5\frac{3}{8}$ inches long and wide in proportion, clasped firmly at the butt for removing the oysters from off the rocks, their method of action being very similar to a pick. On Mornington and Forsyth they are known as *riambi*, the same name applied to the stone which the islanders told me has since been replaced by the blade of the iron scrapers."

In a subsequently added note, Roth commented on a theory he had previously held, that these stones were fire flints. He says, "In connection with these picks on Bentinck Island, where they were first discovered, it may be

mentioned that, although no punk was seen associated, I originally suggested that, whatever else they might be, they acted the part of flints in raising fire, they certainly gave rise to a spark when struck. Colour was lent to the suggestion by the fact that on each of my visits here, all the members of my party carefully examined the camps for fire sticks, but with a negative result, and I am still puzzled to know how these make fire. The timidity of the Bentinck natives is such that only on one occasion, during the course of three visits, have I been able to come into direct touch with them. They neither communicate with the mainland and neighbouring islands, nor speak the same language as the Mornington and Forsyth blacks, which has been identified: in fact, they appear to have been isolated from the outside world long prior to the time when the present inhabitants first occupied the neighbouring islands of the group."

Bentinck Islanders, called Malununda [Malunumde] were among the shyest of people and Roth failed to meet them until, on his third visit to their island, his boat crew cornered them. Even on this occasion they escaped into the water up to their waists to avoid their supposed enemies. This explanation covers Roth's peculiar reference to coming into "direct touch" with Bentinck Islanders.

My Mornington Island informants did not support the fire-making theory and were in fact rather amused by it. Their own method was by friction of two sticks, one, a short hardwood stick, being rotated against the margin of another softer one, laid on the ground. The term *riambi* used by Roth for these implements was unfamiliar to them.

As a result of the obtaining of this data on the stones, a correspondence was entered into with Rev. John Dougherty of Mornington Island. Among other details an abstract of text and a sketch from Roth's account was sent. In reply, on 10th December, 1941, he wrote:

"With reference to the oyster picks (*riambi*) as named in your sketch, I have made enquiries about them and find that they are still in use and have not been replaced by any iron implement. According to the enquiries I have made, their only use is for the getting of the oysters and not, as Dr. Roth stated, for the making of fire. The name used for the oyster pick both by Mornington and Bentinck people is *mariowa*. There are no natives [now] on Forsyth Island, the natives having migrated to Mornington and the mainland. Referring again to the oyster picks and the composition of the rock used, I would not say it was as Dr. Roth states, but to me it looks very much like a reddish porphyry, though I would point out that I am not a geologist. I will endeavour to procure for you specimens of these picks and send them along with the other specimens. Answering your other question, whether the stone was

only used by the women, the answer is negative, as both men and women use the picks or *mariowa*. Regarding the fire-making, the Bentinck Islanders make their fire by rotating a short stick into another laid on the ground; the stick is rotated between the palms of the hands, the native sitting down in the process.''

At first reading of the above comments it would seem that Mr. Dougherty was able to find only one use for these implements, namely as oyster picks, but it must be remembered that in so writing he was concerned only in denying their suggested use as fire-makers. In other respects his information tallies with that obtained from my Lardil men.

Confirming his promise, Mr. Dougherty sent to the South Australian Museum, early in 1942, a series of five stone picks. Several of these have been figured in this account.

Details of the five specimens from Mornington Island are:

No. of Specimen	A.31332	A.31331	A.31349	A.31329	A.31330
Length	145 mm.	140	110	105	88
Breadth	50 mm.	57	53	63	56
Thickness	42 mm.	45	38	45	43
Weight	312 grams.	454	227	340	225

The material used for the stone picks of Mornington Island is a quartz porphyry which weathers readily to a reddish colour, in which the glassy quartz crystals are evident.

A typical stone pick is an amygdaloidal implement of crude biface form with about equal primary trimming on each face. The shape of this implement may be modified away from this form if it has had an undue amount of use as a pick against hard surfaces, with the probability of the uncontrolled removal of large flakes. At first glance, when held at the most convincing angle, a stone pick appears not unlike a rough *coup-de-poing*, although it is usually more elongated and far thicker in section than in normal hand axes from the Old World. In this regard it closely resembles some crude biface implements from Poondi, in India, which are present in the South Australian Museum collection. Figures 3–7 give several views of one implement (A.31349). At the broader end it is rather more slender than usual. Its final appearance has been influenced, however, by a casual fracture along the butt, a flaw which took away a piece of the top of the stone, as is evident at the top left in Fig. 3. Figures 8–11 show another stone pick (A.31330), this one is a more squat type, round almost circular in transverse section. This specimen has seemingly developed as an end product of much wear and retrimming on a good stone. Figures 1 and 2 give two similar views of a third stone (A.31331). It has two opposed cutting edges with biface trimming.

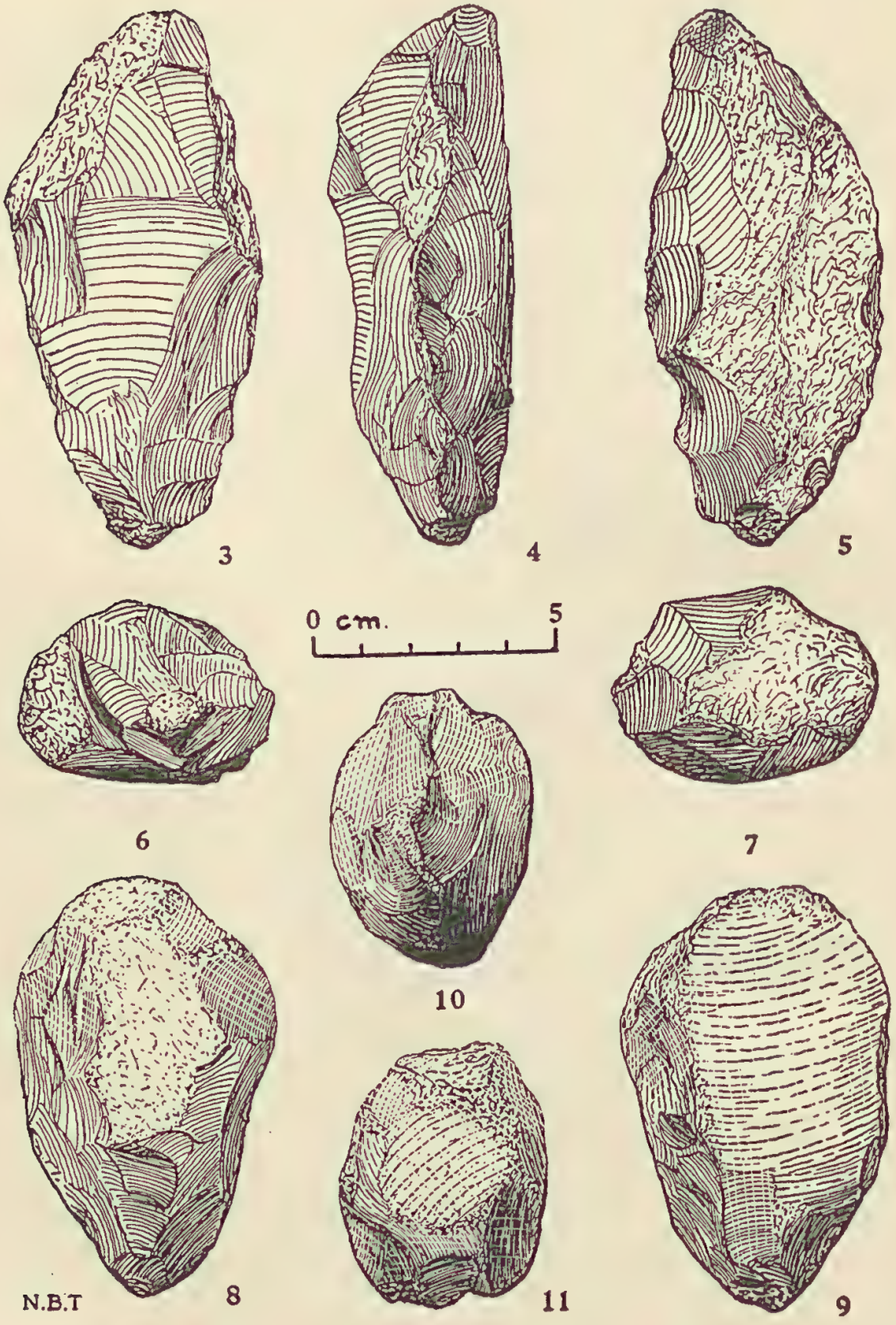


Fig. 3–11. Two *mariwa* implements from Mornington Island. Fig. 3–7. Five aspects of specimen A.31349. Fig. 8–11. Four views of specimen A.31330 (× ⅔).

Using these specimens, a useful check can be made on the methods of employment suggested by my Mornington Island informants. If specimen A.31330 be placed in the cutting hold, two, and only two, cutting edges appear; these form the lower left margin in Fig. 8 and Fig. 9 respectively. Similarly in specimen A.31349, cutting edges appear as on the lower left margins of Fig. 3 and Fig. 5. The last-named specimen had continued to be used on the margin shown in Fig. 3, in spite of this edge having been rendered less effective by reason of irregular spalling along a natural fracture line. In specimen A.31331 there is one relatively good cutting edge, as shown in Fig. 1. Traces of the opposite cutting edge are present, but are preserved only on the upper half of the stone, the rest evidently having been spalled off on a large flake, detached late in the history of the implement, while in use as a pick. This defacing flake scar is depicted in Fig. 2.

Specimen A.31332, not figured, possesses a very characteristic pick point; it is worn and battered. In its original form it was evidently similar to the others; however, a late fracture seemingly reduced part of the rounded head, leaving an edge resembling one appearing on a regularly fashioned and rounded "end-scraper". Traces of shell lime still on it suggest that this accidently created edge may have been used in oyster gathering. It was presumably held, in this case, in a position diametrically opposite to that illustrated in Fig. 2.

The particular interest to be seen in these stone picks or *mariwa* is that among the Wellesley Islanders there survives to this day, a stone implement of the biface family, affording a slender but very tangible link with the age-old *coup-de-poing* or hand axe of the older Palaeolithic of Europe, Africa and Asia. Since there is no first-hand knowledge on how the Palaeolithic implements were used, the observations here recorded afford for the first time a little direct evidence as to how some stone implements of biface type are used. These observations, particularly those on the "cutting hold", may also throw some light on how the general run of Old World bifaced hand axes were held when in use.

A BIFACE IMPLEMENT FROM SCADDAN, WESTERN AUSTRALIA.

The hand axe-like biface implement found by Mr. B. Randall near Scaddan is illustrated from three directions, reduced to one-half natural size, in Fig. 12–14. Length of the available portion is 110 mm., width 83 mm., and thickness 43 mm. The specimen had suffered, prior to finding, an injury, with loss of the narrower extremity. A theoretical reconstruction of its possible former shape is shown in dotted outline in Fig. 12 and 14. The injury appears to have been done when it was in use, since the abruptly fractured face is patinated in a manner similar to the rest of the implement.

The implement has been hammer-flaked on both faces, and the edges secondarily worked with a step-flake technique. The trimming of the implement is sinuous and, when viewed from the sides, as is well shown for one margin in Fig. 14, on both lateral margins there is a loop, concave on the right, convex on the left. The possible significance of this sinuous margin is referred to below.

The edges show some degree of wear or battering, and also some sharp corners have been battered or abraded. The battered edges are indicated in the accompanying figures by dots. Several rounded nodular inclusions are present

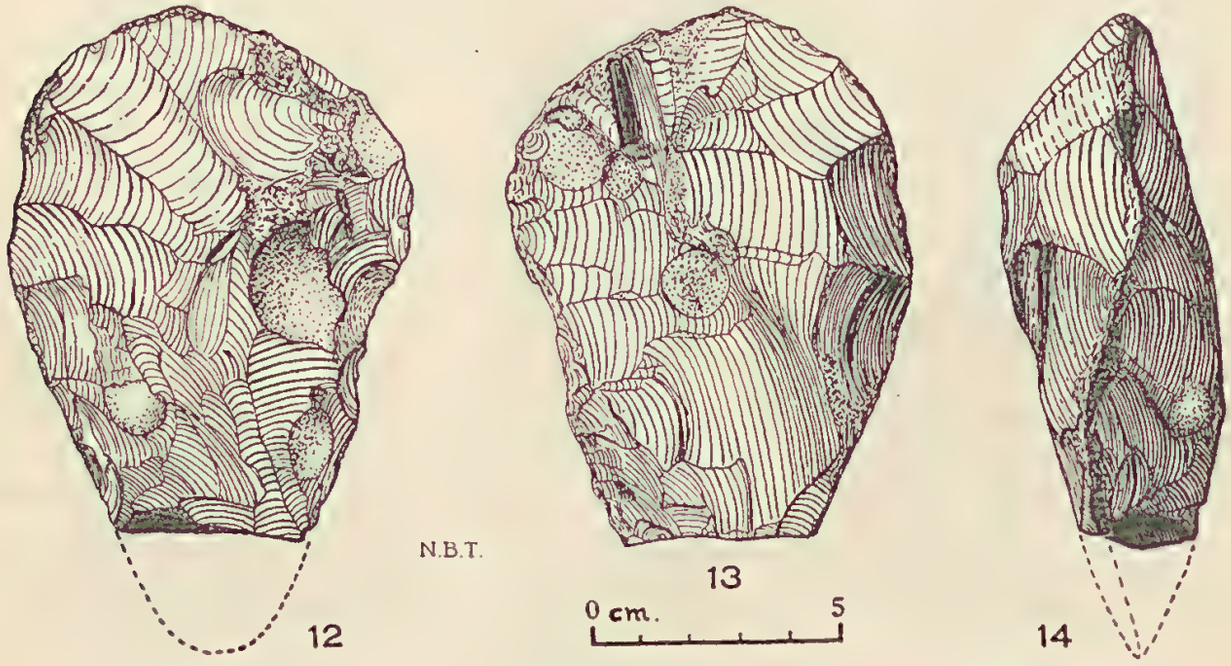


Fig. 12–14. Biface implement found near Scaddan, Western Australia. Specimen No. 9636 in W.A. Museum (× ½).

in the flint and hemispherical portions of these are present on the surface of the implement. The flint is fine and smooth. It is now patinated to a bright reddish-yellow colour. The type of flint material of which the implement is made, could have been derived from coastal deposits of Miocene flint, present not much more than 50 miles to the eastward of Scaddan. They appear often as rounded flint boulders. Both fresh and weathered outcrops of them appear at intervals wherever, in the Great Australian Bight, the southern margins of the marine limestones underlying the Nullarbor Plain have been eroded by the sea.

The present biface implement from Scaddan, registered number W.A.M. 9636, was found by Mr. Randall about 1930 during the excavation of surface soil and laterite gravel in the making of the main road from Norseman to Esperance. The actual site was on a plain 35 miles inland, north of Esperance.

In 1939, with Dr. J. B. Birdsell, an opportunity occurred to visit the area where this implement had been found. It proved to be on a broad, virtually treeless, laterite-gravel covered plain, extending for many miles, with only slight undulations and occasional washed out gutters, several feet in depth. These did not, however, cut through the laterite soil layers. Water was scarce in the area and no definite signs of former native occupation could be detected. One day's searching of such erosion gutters in the vicinity yielded no useful evidence. It seemed likely, however, that the yellow staining of the patinated flint, which is equally well affected on both faces of the implement, might have developed by burial in such a lateritic soil.

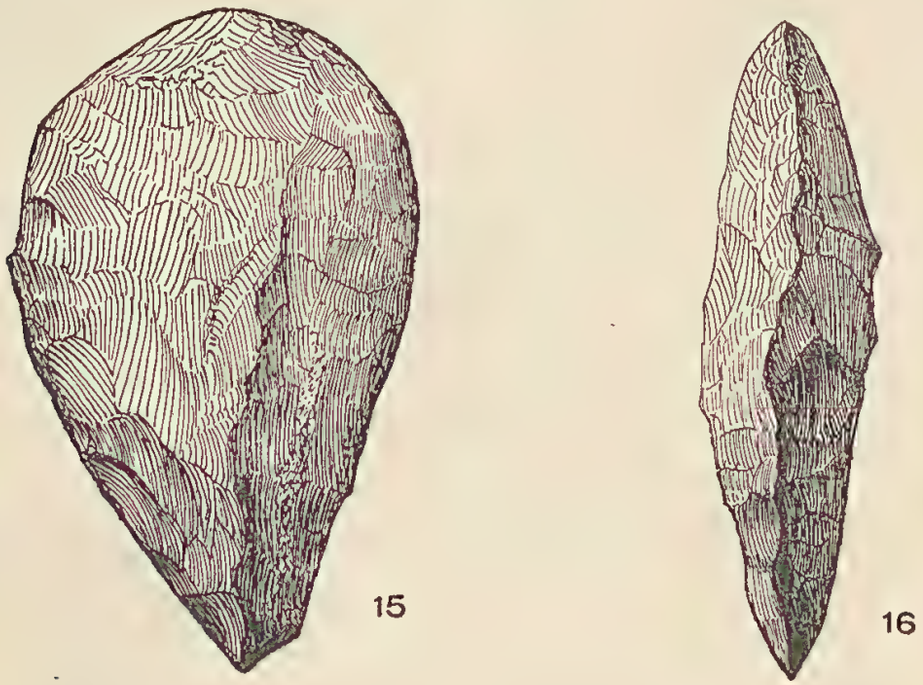


Fig. 15–16. Biface implement from Borneo (after Lane Fox).

The significance of an isolated find of this kind is difficult to assess. It does extend the known range of implements of biface type to a new portion of the Australian continent. They have been known from the South-East of South Australia for many years. Almost all of the South Australian specimens have been found in association with relatively limited areas of Miocene flint. The South Australian examples include relatively few implements either so well finished or as typical of the *coup-de-poing* type of implement as is this one. Study of these implements in South Australia is not far advanced, since only recently has the area of their occurrence been adequately studied in the field. Previously for many years findings of these implements had been exploited by a

commercial collector without disclosure of their source. The only directly comparable specimen other than the South Australian finds is perhaps the earliest recorded example from the area south-east of Asia. This is the specimen (Fig. 15–16) found by Mr. Everet in Borneo and described briefly by Lane Fox (1872, p. lxxxix, fig. 1).

Lane Fox (1872, p. xcvi) was one who drew attention to the sinuosities in the margins of *coup-de-poing*. He considered them to be purely accidental. It is of interest, however, that such a feature appears in the Scaddan example, as well as in the stone picks described in the first half of this paper. With further study it may be possible to establish that there is a direct relationship between mode of use, or of retrimming during use, and the development of this sinuosity. In such a case it may well be that the mode of handling of the *mariwa* of Mornington Island, in cutting, was one also characteristic of *coup-de-poing*.

SUMMARY.

This paper records particulars of the modes of use of crude bifaced stone hand-axe-like implements called *mariwa* on Mornington Island, Queensland. It records also the casual find of a biface hand axe of flint near Scaddan in South-Western Australia.

REFERENCES CITED.

Lane Fox, A. (1872) : *Proc. Ethn. Soc.*, London, 1870.

Roth, W. E. (1904) : North Queensland Ethnography Bulletin, No. 7, Brisbane.

FAUNA AND FLORA OF THE GREENLY ISLANDS, PART I

INTRODUCTORY NARRATIVE AND VERTEBRATE FAUNA

BY F. J. MITCHELL AND A. C. BEHRNDT.

Fig. 1–2.

IN December, 1947, a party of five men, comprising members of the Adelaide Bush Walkers, Messrs. H. A. Lindsay (President), C. Hutchinson, A. Williams, and the junior author, together with F. J. Mitchell of the South Australian Museum staff, visited the Greenly Islands.

The object of the trip was to make as complete a survey of the islands' fauna and flora as a stay of ten days would allow, in order to ascertain whether the islands supported sufficient native life to warrant an endeavour being made to have them declared a permanent sanctuary.

The islands have an approximate base area of 680 acres, and are huge bosses of fine grained biotite granite, rising abruptly from the Southern Ocean in latitude 34° 39′ S. and longitude 139° 37′ E. They are approximately one and one-half miles long, and at a maximum half a mile wide. The main island consists of an approximately east to west ridge, which rises to a peak summit of 750 feet at its eastern extremity. Toward the north-west it is subdivided by a crevasse through which the sea surges continuously over partly submerged rocks. The passage between the two islands is negotiable on foot when the sea is calm.

The south-western section is almost detached by a similar but more spectacular chasm, with only a saddle of rocks and wind-blown sand bridging the gap between the two granite masses. About 250 yards off the eastern end of the island lies Seal Rock, a granite islet about 250 yards in diameter and covered toward its summit with low herbage.

Shortly after midday on 7th December, 1947, the cutter "Wandra" carrying the party dropped anchor within 100 feet of the shore in six to seven fathoms of water, on a sandy bottom, and a landing was achieved on a narrow rocky edge, immediately to the right of a blow-hole in the cliff face. This appears to be the only safe landing place, for although access has been gained on the southern side of the island the swell renders the operation hazardous. Elsewhere the granite face plunges almost perpendicularly into the sea, there being no beach or shingle.

The vegetation is non-eucalypt and on the main island consists principally of a dense entanglement of Sheoak (*Casuarina stricta*) and Titree (*Melaleuca*

pubescens), the Sheoak predominating along the central ridge and northern slopes, while on the southern slopes the Titree is almost impenetrable. The Titree appears to be much more tolerant of the salt conditions than the Sheoak, as the dense Titree scrub extends to within 150 ft. of the southern seaboard, being particularly dense over the isolated patches of travertine limestone. The Sheoak which does extend to the southern slopes is for the most part stunted, and considerably twisted. Whereas, the grasses and other small plants have been greatly depleted by the wallabies on the main island, they grow in profusion on subsidiary areas, presumably not occupied by wallabies. These heavily vegetated parts probably play an important part in the ecology of the main island, as there must be continual wind-blown reseeding from these virtually insular areas.

Evidence of earlier human visitors was found at several places. A recent camp, presumably that of Mr. H. H. Finlayson, who landed just prior to the present party to observe the wallabies was found at 250 feet in a Titree clump on the northern slopes, while an old three-sided rock shelter and fireplace was discovered immediately below the main ridge to the left of the landing place. In addition, a layer of about half an inch of carbonaceous remains, apparently those of a fire, were found beneath a layer of about two inches of consolidated penguin excreta in the floor of the only natural rock shelter on the island, a cave in the northern face. Although much of the scrub appears to be virgin, charred lichen-covered Sheoak stumps at several places toward the eastern end indicated an early scrub fire.

Relevant to the above is some information supplied by an old Eyre Peninsula identity, Mr. W. G. Morgan of Coulta. When young, Mr. Morgan was associated with T. B. Hawson, one of a family of well-known Eyre Peninsula pioneers. Hawson told him of Billy Dunn, a dark-skinned sealer of probable Malay extraction, who spent many months sealing on Greenly Island together with his full-blooded aborigine wife, Charlotte. When their boat sank in the passage to the seaward of Point Sir Isaac while taking a load of seal skins from the island to Port Lincoln, Dunn was drowned. His wife managed to struggle ashore.

No potable water supplies of appreciable size were found, although at the foot of the granite sheets near sea level, several small seeps were located. These were for the most part too highly mineralized and of insufficient quantity for human needs. From the largest (see fig. 1) six gallons (two by day and four by night) were collected and later used for cooking and washing purposes. This visit was made during a prolonged spell of hot, dry weather, and no doubt under cooler conditions a more favourable position would be found. A large pool fed

by a seep and estimated to have a capacity of 60 gallons was found near sea level on the eastern side of Anthoney Island. This cavity was polluted by seals, but if cleaned out and allowed to refill may furnish a suitable supply.

Owing to the absence of a sandstone or limestone cap to act as an aquifer, the steep sides of the island, and the impervious nature of the granite, the island rapidly sheds most of the rain. This is indicated by the numerous channels cut in the granite face of the island by the rain water as it rushes seaward. The largest of these is about 12 feet wide, 100 feet long, and 3 feet deep. Blocking of some of these channels would create small water reservoirs in an emergency. Rudiments of a former limestone cap were found on the southern slopes, where several large sheets of limestone appear to have been checked in their slide toward the sea by granite ledges.

The soil of the island consists of powdered granitic sand intermixed and heavily covered with vegetable debris. It is anchored by the roots of the trees to a depth, in places, of as much as two feet, although on the average only a few inches. A widespread fire would soon denude the island of vegetation by permitting the rapid wind and water erosion of the loose sandy soil.

The map (fig. 1) was compiled by the present party and we have to thank the Lands and Survey Department, Port Lincoln, for assistance in allowing us to borrow instruments to facilitate its compilation. Time did not permit the accurate plotting of the topography, but the key heights were taken and the approximate 100-ft. contours have been drawn in from sight. The names shown on the map have been submitted to and accepted by the Nomenclature Committee of the Royal Geographical Society of South Australia.

This survey has indicated the desirability of declaring the islands with their fauna and flora a sanctuary, thus protecting them from interference. From an economic viewpoint there are no apparent reasons against such a proposal; there are no guano deposits of commercial value thereon, its small area is of generally rugged nature making it unsuitable for pastoral purposes, while there are no Mutton Bird rookeries to exploit. The almost complete absence of alien plants and animals likely to interfere with the welfare of the native life is a further favourable factor.

MAMMALIA.

The mammal section of this paper is a brief account of the observations of the party and no attempt has been made to deal taxonomically with the material collected. It is expected that a more detailed report will be prepared by Mr. H. H. Finlayson, who landed a few weeks prior to the present party expressly to study the mammals.

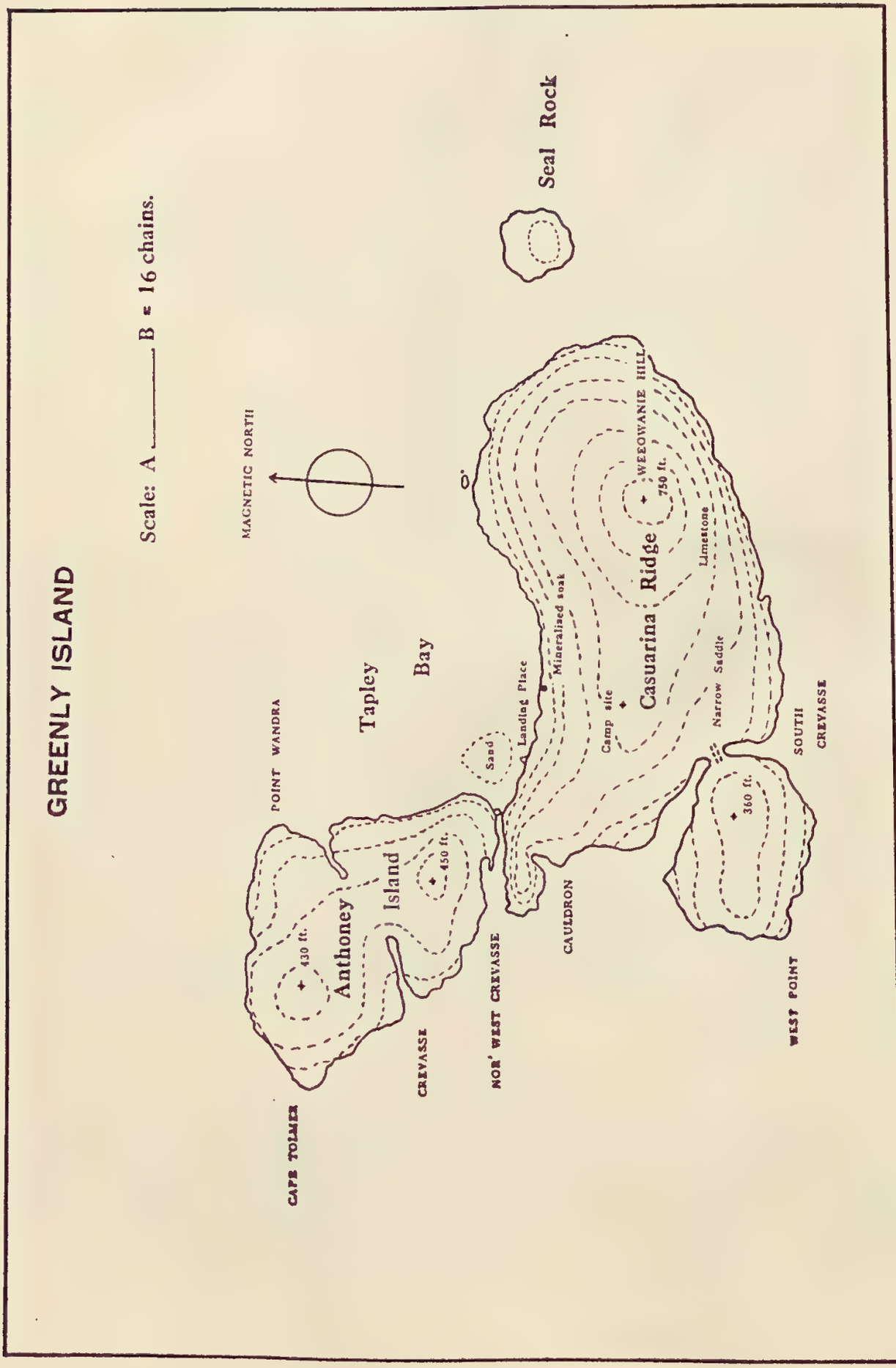


Fig. 1. Map of the main island and adjacent islets.

The island supports four species, three indigenous and one introduced. The Hair Seal *Arctocephalus cinereus* was the first to make itself known, curiosity having led several specimens into swimming out to greet us. Later a small colony of nine Fur Seals *Arctocephalus doriferus* was found living in the turbulent waters of the Nor'west Crevasse. This small community remained almost exclusively on a ledge, sunning themselves by day and going out through the crevasse into the Southern Ocean swell to feed in the early morning and evening.

The Scrub Wallaby *Thylogale eugenii* was first seen on the evening of the day of landing, several specimens being flushed in the scrub immediately behind the camp. This wallaby is believed to have been introduced from Kangaroo Island in about 1905 to act as an emergency food supply for possible castaways. The fourth mammal, a native rat, *Rattus murrayi* var. was not observed during the first few days, although later it made its presence more than felt by impudent and fearless explorations among our gear and food supplies.

Considerable interest was attached to the wallaby population, as it had been hoped that a species of Rock Wallaby (*Petrogale*) allied to an extinct mainland species might be found on this isolated island. However, although some seventy skulls were examined, all were those of the introduced Scrub Wallaby, and no signs were found of any other species.

The wallaby has overrun the main island, and signs of its activities can be seen everywhere. It has eliminated many of the smaller plants, which are abundant on the subsidiary islands, and the dense titree scrub is a network of low tunnels. Although it is difficult to assess the size of the population owing to the large area of dense scrub and sameness of the many groups, it is estimated that the number of wallabies would approach three figures. Although no live specimens were seen, several skulls collected on Anthoney Island indicate that some specimens are, or have been at some time, there also. The dense profusion of ungrazed vegetation and the absence of regular pads indicates that few, if any, are at present living there. No specimens or skulls were found on the semi-detached south-western sector, the drop from the main island ledge to the connecting saddle apparently forming a barrier to their migration. Observations of the wallabies feeding in the open in the early morning and evening revealed that there were two colour phases, a minority of specimens being a noticeably darker shade of brown than the normal grey-brown specimens. When small groups were disturbed from the scrub during the day it was evident that the darker phase kept to a large extent separate from the bigger mobs of lighter coloured individuals. While feeding during the evening both phases intermingled freely.

The native rat, a form most nearly allied to *Rattus murrayi* Thomas, which species was first taken by Professor Wood Jones on Pearson Island some 60 miles north of Greenly, was extremely numerous, and our camp on the main ridge provided an attraction for them. The noises of their scavenging about the camp in search of supplements to their presumably vegetarian diet was almost as big a barrier to sleep as the raucous calls of the Fairy Penguins. In spite of searches under stones and through the various tunnellings in the sheoak and titree debris, no sign could be found of the rats by day. Although no specimens were seen, similar tunnels on Anthoney Island indicated that the rats were there also. During our stay twelve specimens were shot and preserved for examination. It is interesting to add a further observation to the previously noted predominance of males.[1] Of the specimens shot, ten were males.

The Hair Seal colony, which extends along the whole of the partially sheltered northern side of the island, contains more than 100 individuals. These were found in small family groups, generally a bull, two or three cows and several pups basking on the rocky ledges of Tapley Bay by day, then foraging for food during the evening and early morning. As the breeding season had finished some weeks previously, all pups took readily to the water. Sometimes the Hair Seals would climb hundreds of feet up the precipitous face of the island, and one individual, possibly sick, was found on the crest among the scrub. The presence of a small colony of nine Fur Seals in the broken water of the Nor'west Crevasse indicates that these animals are gradually becoming re-established on the islands to the South of Eyre's Peninsula, and it is hoped every effort will be made to prevent a re-occurrence of the slaughter which occurred about thirty years ago.

AVES.

During our short stay observations were made on fifteen species of birds. Several of the marine birds and four non-marine species were found to have established permanent breeding colonies. These non-marine birds are the Red-cap Robin, *Petroica goodenovii;* the Welcome Swallow, *Hirundo neoxena;* the Silver-eye Finch, *Zosterops lateralis*; and a Crow, *Corvus sp.*

The following species were observed:

RED-CAP ROBIN, *Petroica goodenovii* Vigors and Horsf.

This colourful robin is common, and was found to be breeding freely, nests being frequently observed in the isolated patches of Titree along Casuarina Ridge. One nest immediately behind the camp contained three young, and it appeared as if there were more immature birds than adults.

[1] Wood Jones (1924): *Trans. Roy. Soc. S.A.*, xlviii, p. 11.

SILVER-EYE FINCH, *Zosterops lateralis* Lath.

This finch was also common, although less observed, as it favoured the stunted Titree growing on the precipitous slopes and ledges below 250 feet. Although no nests of this species were definitely recognized, several young birds incapable of sustained flight were observed.

YELLOW-WINGED HONEY-EATER, *Meliornis novae-hollandiae* Lath.

Three somewhat bedraggled specimens were found in the Titree on the northern slopes of the island during the first week and one was shot for the collection. The remaining two were later observed on Anthoney Island.

ROCK PARROT, *Neophema petrophila* Gould.

Flocks of these birds apparently make deliberate periodic trips to the island, as several flocks were seen arriving and others departing in a direct line to the mainland. The reason for their visits was not definitely ascertained, but they were often disturbed on the ground, and it has been suggested that the pig-face seed, of which there is an abundance, is the attraction.

WELCOME SWALLOW, *Hirundo neoxena* Gould.

Swallows were found about the ledges and caves below the ridge of the main island, although invariably away feeding over Anthoney Island in the early morning. It was interesting to note the far greater use of sheoak needles and other organic matter in the nests of these birds on an island where good binding earth is absent.

CROW, *Corvus sp.*

No specimens of the crow were taken, and in consequence a positive identification was not made. Seven birds roost regularly in two large sheoak trees, just below the summit of the island. These trees contain several nests, only one of which appears to have had recent use.

NANKEEN KESTREL, *Falco cenchroides* Vigors and Horsf.

A single specimen was seen preying on the lizard *Egernia whitii multiscutata* which abounds.

WHITE-HEADED OSPREY, *Pandion haliaetus* Lin.

A pair of these eagles has taken up permanent residence on the island, and two enormous nests were found near the summit and another on Anthoney Island. They undoubtedly take considerable toll of the young wallabies, as numerous skulls and other wallaby remains were found about the nest sites. Beneath several large sheoak trees, the remains of several large wallabies and

birds were found, and it is suspected that these trees are used as feeding trees by one of the larger eagles, presumably the White-breasted Sea-eagle, *Haliaeetus leucogaster* Gmelin. However, no specimens were seen.

FAIRY PENGUIN, *Eudyptula minor* Forst.

By day the penguins were found in burrows under rocks to a height of about 350 feet. Although the breeding season appeared to have been completed, several young specimens were found in breeding burrows high up on the island. These juvenile and several moulting specimens were examined for exoparasites and found to be badly infested, it being evident that they had not entered the water for some time. These parasites were not present on fully feathered specimens.

CAPE BARREN GOOSE, *Cereopsis novae-hollandiae* Lath.

Three pairs of these fine birds were seen on Anthoney Island. They could be approached quite closely before taking alarm.

PACIFIC GULL, *Gabianus pacificus* Lath.

This gull was numerous and a nest containing two well-developed young was found on a rocky ledge on Anthoney Island. The amazing swallowing powers of this bird were illustrated on several occasions when specimens pirated our fish catch. Parrot fishes of up to three-quarters of a pound weight were swallowed with apparent ease.

SILVER GULL, *Larus novae-hollandiae* Steph.

Big flocks visited the island of an evening and roosted on Seal Rock.

CRESTED TERN, *Sterna bergi* Lich.

Several small flocks were seen about Tapley Bay.

SOOTY OYSTER-CATCHER, *Haematopus unicolor* Wagl.

Many were seen about the ledges of Tapley Bay and on several occasions a pair waited about to clean up any surplus shell-fish bait after we had finished fishing.

MUTTON BIRD, *Puffinus tenuirostris* Temminck.

Contrary to expectations no Mutton Birds were found, although several were observed flying about the boat as we approached Tapley Bay. On the eastern end of the island a series of old nesting burrows was found, but it was obvious that these had not been used for several seasons.

REPTILIA.

Although present in great numbers, examples of only six species, representing two families of the *Lacertilia* were collected. Of these, two species of the *Scincidae* are represented by single specimens. The gecko, *Phyllodactylus marmoratus* Gray, and the skink, *Egernia whitii* Lacep., were the most abundant species.

Except where a discussion on the synonomy has been introduced, only the original reference to each species has been given for brevity.

SAURIA.

Family GECKONIDAE.

PHYLLODACTYLUS MARMORATUS Gray.

Diplodactylus marmoratus Gray, 1845, Cat. Lizards, p. 149.

The gecko appeared to be the most abundant species and a large series of specimens was collected. They show no structural differences from mainland specimens. The colouration is very variable.

Measurements of a large specimen: 97 (49+48) mm.—tail regenerated.

Family SCINCIDAE.

EGERNIA WHITII Lacepede.

Scincus whitii Lacepede, 1904, Ann. Mus. Paris, iv, p. 192.

This species is also common, it being present in large numbers wherever there is sufficient fallen timber or loose granite to provide cover. Contrary to the findings of Proctor[2] all ten specimens collected show a more uniform scalation than is normally found in mainland populations of this species. Although some of the head-shields are often subdivided, the relative lengths of the principal sutures are comparatively constant.

In general appearance these specimens closely resemble the typically coloured mainland material with the usual light brown vertebral stripe, broadly bordered on either side by a black stripe enclosing a series of light brown spots. However, they show a marked increase in the number of mid-body scale rows, 32–38 being the range generally quoted for the species, and 40–46 is the range indicated by these ten specimens. The dominant mid-body scale count is 43. Another outstanding difference is the relative proportions of the interparietal,

2 See also Proctor, 1923, *Trans. Roy. Soc. S.A.*, xlvii, p. 80.

it being as wide as, or wider than, and only about two-thirds as long as the frontal. The above differences make it apparent that the Greenly Island population constitutes a distinct insular race and the name *multiscutata* is here proposed for it.

EGERNIA WHITII MULTISCUTATA subsp. nov.

Prefrontals, frontoparietals and interparietal distinct, the latter completely dividing the parietals and making contact with the single pair of nuchals; as wide as or wider than and only about two-thirds as long as the frontal; frontonasal separated from the frontal by the prefrontals which form a median

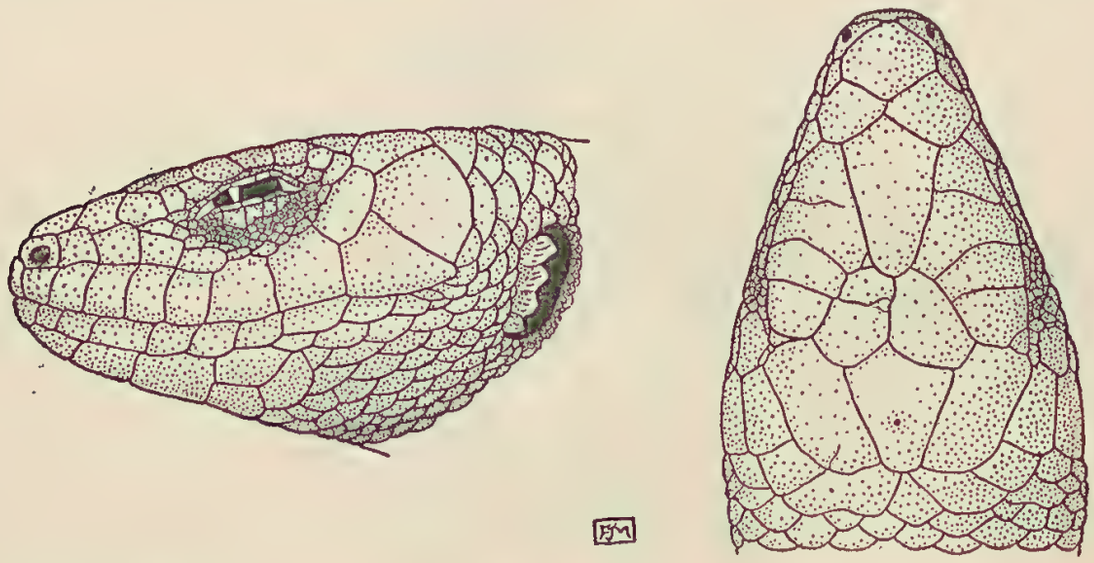


Fig. 2. *Egernia whitii multiscutata*: dorsal and lateral views of the head of the holotype male (×3 approx.).

suture; in contact with the rostral. Limbs relatively long, when adpressed along the body they overlap, bringing the ankle and the wrist into contact. Five supraoculars, second largest, in contact with the frontoparietal; 7–10 supraciliaries, the first greatly enlarged; three temporals, posterior large, triangular. Three or four white auricular lobules present. There are 43 smooth scales at mid-body and 25–29 unicarnate lamellae under the fourth toe.

Colour: A light brown dorsal stripe broadly bordered on either side by a dense black stripe enclosing a series of light brown spots. Remainder of dorsal and lateral surfaces irregularly mottled with dark and light brown, the darker colour predominating. Auricular lobules white and an occasional white scale in the dorso-lateral body area. Ventral surfaces a uniform light brown to grey with a dark blue marbling under the throat. One paratype male had a bright orange ventral surface in life.[2]

Distribution: Holotype, allotype and eight paratypes, S.A.M. R.2636, Greenly Island, S.A.

Measurements: Holotype male. Total length: 214 mm.; body length: 88 mm.; tail length: 126 mm.; head length: 20 mm.; fore limb: 27 mm.; hind limb: 39 mm.

HEMIERGIS PERONII Fitz.

Seps peronii Fitzinger, 1826, Neue classif. Rept., p. 53.

Six specimens were taken on the main island. All are typical of mainland specimens.

Measurements of the largest specimen: 138 (53+85) mm.—tail complete.

RHODONA TETRADACTYLA Lucas and Frost.

Rhodona tetradactyla Lucas and Frost, 1895, Proc. Roy. Soc., Vict., vii, p. 268, and 1896, Rept. Horn Exp., ii. p. 142, pl. xii, fig. 3.

Rhodona frosti Zietz, 1920, Rec. South Aust. Mus. I, p. 217.

A single specimen was taken at the extreme peak of the island. It compares well with the type description and figure. The four dorso-lateral series of spots are confluent into lines.

Measurements: 70 (57+13) mm.—tail incomplete.

Since Loveridge[3] arrived at the conclusion that the elevation of *Rhodona* and other former subgenera of *Lygosoma* to full generic status would simplify the classification, *tetradactyla* is no longer pre-occupied, and must therefore hold precedence over the new name, *frosti*, proposed by Zietz.

ABLEPHARUS GREYII Gray.

Menetia greyii Gray, 1844, Zool. Erebus and Terror Rept., pl. v, fig. 4.

One specimen was taken in some sheoak debris at the camp. The general colouration of this specimen closely resembles that of *A. lineo-ocellatus* Dum. and Bibr. with an irregular dorsal series of black spots and occasional ocelli. However, it is immediately distinguished by the digits 5+4 and the unique supra-ocular scalation. The mid-body scale count of 22 appears to be very constant in South Australian examples.

Measurements: 39 (29+10) mm.—tail regenerating.

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[3] Loveridge, 1934, *Bull. Mus. Comp. Zool, Harvard*, lxxvii (6), p. 247.

ABLEPHARUS LINEO-OCELLATUS Dum. and Bibr.

Ablepharus lineo-ocellatus Boulenger, 1887, Brit. Mus. Cat., iii, p. 348 (syn.); Zietz, 1920, Rec. S. Aust. Mus., i, p. 220.

Ablepharus lineo-ocellata Proctor, 1923, Trans. Roy. Soc., S. Aust., xlvii, p. 81.

Ablepharus lineo-ocellatus var. anomalus Boulenger, l.c., p. 349.

Ablepharus lineo-ocellatus anomalus Loveridge, 1934, Bull. Mus. Comp. Zool., lxxvii, p. 377.

Ablepharus lineo-ocellatus var. *adelaidensis* Boulenger, l.c., p. 349; Kinghorn, 1924, Rec. Aust. Mus., xiv, p. 181.

This lizard is fairly abundant along the main ridge of the island, although exceedingly difficult to catch, as it disappears rapidly into the dense sheoak debris upon approach. Only two specimens were captured.

The mid-body scale counts are 28 and 30 and the supra-nasals are present in both specimens. Some dorsal ocelli are present in the smaller specimen.

Measurements of the larger specimen: 97 (55+42) mm.—tail regenerating.

Since the description of this species by Dumeril and Bibron in 1839, several attempts have been made to explain the large variation by dividing it into races. In endeavouring to find the race to which the above specimens belonged, a series of thirty-four examples from eighteen localities within South Australia were examined with the following result. Mid-body scale counts of 26 (4 specimens), 28 (8 specimens), 30 (14 specimens), 32 (6 specimens) and 34 (2 specimens) were obtained. Twenty-eight of this series possess supra-nasals, four do not and two have them present on one side and absent on the other. The colouration is also very variable, fourteen being with and twenty without the dorsal ocelli. Four specimens from widely separated localities in Western Australia were kindly made available for examination by Mr. L. Glauert of the Western Australian Museum. These four specimens appeared to partially contradict the findings of Loveridge (1934), as all four possessed supra-nasals and had the dorsal ocelli very conspicuous. The mid-body scale counts were 26 (3 specimens) and 28 (1 specimen). Kinghorn (1924) records a specimen as "var adelaidensis" from Cranbrook, Western Australia which possesses supra-nasals and has only 20 mid-body scale rows; also one "typical" specimen, presumably without the supra-nasals from Bornham, Western Australia.

The above results, together with those obtained by Peters (1874), Boulenger (1887), Loveridge (1934) and others, tend to indicate that this variation is in no way correlated with locality and therefore of doubtful taxonomic significance.

PISCES.

Owing to the limited time at our disposal and the absence of foreshore, no attempt was made to obtain a marine collection. However, in our endeavours to obtain fresh fish for food, several species were captured and a mention of these may be of interest.

The bulk of the fishes obtained over the rocky, weedy bottom were Parrot Fishes (*Pseudolabrus*) and four separate species were noted, *P. fucicola* Richardson, *P. miles* Bloch and Schneider, *P. punctulatus* Gunther and *P. tetricus* Richardson. The last-named was found to be the best food fish. Also common in the deeper water is the Blue Groper, *Achoerodus gouldii* Richardson, and several large specimens were caught. Two other species, *Threpterius maculosus* Richardson and *Scorpaena ergastulorum* Richardson, were also taken.

SUMMARY.

Notes are given concerning the physiographical features and fauna of the little known Greenly Islands, South Australia. A scincid lizard (*Egernia whitii multiscutata*) is described as new.

Note.: Greenly Island was gazetted "a closed area with respect to animals and birds generally" on October 28th, 1948.

A NEW SPECIES OF LYGOSOMA

By FRANCIS J. MITCHELL, South Australian Museum.

Lygosoma (Sphenomorphus) taeniata sp. nov.

Description: The distance between the end of the snout and the forelimb is contained one and one-half times in the distance between the axilla and the groin. Snout moderate, obtuse; loreal region twice as long as broad; nasals making contact behind the rostral; frontonasal broader than long, making contact at a point with the frontal; frontal in contact with the anterior four of five supraoculars; nine or ten supraciliaries. Frontoparietals and interparietal distinct, the latter shorter than the former, together they are only ¾ the length of the frontal; parietals making contact behind the interparietal. Eight upper and eight lower labials, the sixth and seventh upper labials subocular; the sixth making contact with, and the seventh separated by two small sub-oculars from the lower eyelid. Temporals 1+2, the upper posterior very large. Ear opening oval, with two large and three minute lobules anteriorly. 26 scales at mid-body, vertebrals largest; four pairs of enlarged nuchals. Two enlarged preanal scales. When adpressed along the body the hindlimb reaches beyond the elbow; toes slender, subdigital lamellae sharply keeled, 22 under the fourth toe.

A light brown vertebral stripe is bordered on either side by two white stripes of the same width. A further white stripe runs from behind each eye dorso-laterally along the body. Between the white stripes is a regular brown and white patterning; prominent brown and white vertical barring on the flanks. Limbs with alternate chocolate and white longitudinal bands. Upper labials and ventral surfaces white.

Measurements of the holotype (Registered No. R2803 in the South Australian Museum) total length: 112 mm., body: 40 mm., tail: 72 mm., fore limb: 11 mm., hind limb: 20 mm.

The type specimen was taken by the author in the Andamooka Ranges, immediately west of Lake Torrens, South Australia, in September, 1948. It was found about six inches underground in a burrow of a gecko (*Lucasius damaeus* Lucas and Frost) a pair of which were found at the base of the burrow.

This lizard appears to be allied to *Lygosoma lesueuri* Dum. and Bibr. from which it differs in the greater number of supraoculars, lesser number of mid-body scale rows, greater elongation of the loreal region and in colouration. It is noted that the head shields of the holotype are extremely regular even to the small scales surrounding the eyelids.

AUSTRALIAN RECENT AND TERTIARY MOLLUSCA
FAMILY VOLUTIDAE

By BERNARD C. COTTON, CONCHOLOGIST, SOUTH AUSTRALIAN MUSEUM.

Plates xiii–xvi.

INTRODUCTION

IN this paper an attempt is made to place the numerous species of Recent and Tertiary Volutes in their correct genera. Most of them were originally described under the generic name *Voluta,* but since then other genera have been introduced which show the relationships of the different groups of species and help to explain their origin. An extensive range of material examined by me in connection with work at the Department of Mines, South Australia, has enabled many problems to be solved. The protoconch type is used as the principal basis of classification, supported by general features of the shell, with due consideration of its ancestry. The primitive sculpture was probably of the kind found in the new genus *Austrovoluta* introduced in this paper. It consists of spiral, spaced incisions, and sharp, spaced axial ribs. In Recent genera the spirals are still found in *Fulgoraria* which also has another primitive feature, that of the shallow anterior notch. The development of the axial ribs frequently varies in specimens of the one species and may be strongly developed only in the last whorl.

In *Adelomelon magellanica* the early part of the protoconch is horny. The primitive protoconch was probably small and shelly, but Tertiary and Recent Australian species have many comparatively large protoconchs, the maximum in size being seen in *Mamillana mamilla,* while in all *Melo* species they are large. Trochiform, pupiform and bulbous protoconchs are found and form a good basis for classification.

The columellar plaits are usually consistent in number in a species but once in a while an individual may have one or possibly two extra plaits. Different genera show greater or less development of the plaits so far as solidity is concerned. The adductor muscle is small in the Volutidae so that the plaits provide a greater surface and attachment area for the muscle. Deeper-water genera usually have a correspondingly weaker system of plaits while larger and heavier shells such as *Melo* and *Cymbiola* have stronger plaits.

Genotypes and type localities are given here. Holotypes which are in the South Australian Museum are indicated by their registration numbers. Conchologists recognize three subfamilies, Volutinae, Haliinae and Auriniinae, but only one subfamily, Volutinae, is represented in Australia. *Microvoluta*, genotype *Microvoluta australis* Angas 1877 from N.S.W., has been placed sometimes in the Volutidae, subfamily Volutomitrinae, but it belongs to the Mitridae. A few extra-Australian species are figured for comparative purposes. The plates reproduced here are the work of Miss B. J. F. Newman of the South Australian Museum staff.

GEOGRAPHIC AND TIME RANGE.

Recent localities are abbreviated; the initials referring to the Australian continent as a whole, e.g. N.W.A. = North Western Australia. The range of Tertiary species is indicated by the figures 1,2,3,4,5 each representing a marine stage according to the following list:

1. Werrikooian, Upper Pliocene.
2. Kalimnan, Lower Pliocene.
3. Cheltenhamian, Upper Miocene.
4. Balcombian, Middle Miocene.
5. Janjukian, Lower Miocene.

It may be noted that none of the Tertiary species mentioned occur in the Recent. Nine genera are known only from the Recent, one from the Miocene and Pliocene only, while seven range from the Lower Miocene to Recent and one each from the Middle Miocene, Upper Miocene and Lower Pliocene to Recent.

NOTES ON SOUTH AUSTRALIAN SPECIES.

Lyria mitraeformis. The animal has a dark-cream foot with violet spots. It has been taken at the following localities: Yankalilla Bay 10 fathoms, 20 fathoms, Rapid Head 9 fathoms, 12 fathoms, Eastern Cove, Kangaroo Island, alive at low tide and down to 5 fathoms, dead at 9 fathoms. American River, beach. Hardwicke Bay, large living. Investigator Straits alive in 15 fathoms, dead 20 fathoms. Banks Island 10 fathoms, 1 juvenile alive. Spencer Gulf 13 fathoms, alive. Royston Head, 22 fathoms, alive. Port Lincoln 9 fathoms, alive. Black Point 6 fathoms. Lacepede Bay. Point Sinclair abundant. Port Hughes, Kingscote, Kangaroo Island, 8 fathoms, dead. Porpoise Head, 17 fathoms, alive. Sandbanks at Outer Harbour, lowtide mark, alive. Sub-fossil on raised beaches, Murat Bay and dredged from sub-fossil deposits in the Port River.

Amorena undulata. The species is widely distributed in South Australia being found on sand banks at low tides. It has been taken at the following localities: Yankalilla Bay, 12 fathoms, American River Beach. Corny Point, 30 fathoms, alive. Backstairs Passage 16 fathoms, 20 fathoms, alive. Gulf St. Vincent 9 fathoms. Lacepede Bay. Eastern Cove, Kangaroo Island, alive at low water. Spencer Gulf 21 fathoms. Investigator Strait 17 fathoms. St. Francis Island Beach. Port Lincoln. Pondalowie Bay. Levens Beach. Goolwa. In the Great Australian Bight, 100 to 105 fathoms.

Nannamoria guntheri. This species originally described from Western Australia is typically nodulose at the shoulder, has undulate axial lines and is without the two chestnut spiral bands of *N. adcocki.* Specimens have been taken at Middleton, Encounter Bay and Corny Point 30 fathoms. The variants are as follows:

a. The typical variant, described above, validly angled just above the sutures and in the posterior part of the body whorl. The angle is coronate with eleven plicate tubercles. The ornament consists of rather close-set, axial brown lines, angled forward at the tubercles and backward a little below the tubercles and backward again a little above the columellar plicae, and slightly forward midway between the latter two angles.

b. There may be no axial lines whatever, the shell being of a uniform light-horn colour.

Nannamoria adcocki. This species was originally described from Middleton. It has been taken at St. Francis Island, Port MacDonnell, Robe, Royston Head, Corny Point, Vivonne Bay, Gulf St. Vincent, and also dredged in Investigator Straits 22 fathoms, Backstairs Passage 22 fathoms, Newland Head 20 fathoms, Cape Borda 55 fathoms, Point Marsden 15 fathoms. There are some variants.

a. The shoulder is nodulose; there are two spiral brown lines of which the upper is the narrower, situated just below the angle and just above the plicae where the axials are angled backwards.

b. The axials may be accurately interrupted along a spiral line midway between the two spiral brown lines, with more axials above the line than below.

c. The axials may be more wavy than angled and the waves in different shells may have a very different excursion.

d. There may be no tubercles on the shell and the angle may be quite rounded, the colour markings being still typical.

Remarks on *Nannamoria adcocki* & *N. guntheri* were published in the S.A. Naturalist 24, No. 4, p. 15 and they are included in this general review with slight adjustments.

FAMILY VOLUTIDAE.

Subfamily VOLUTINAE.

Genus VOLUTA Linne 1758.

Voluta Linne 1758. *Syst. Nat., ed.* 10, 729.

Genotype: *Voluta musica* Linne 1758. West Indies.

Remarks: Synonyms of the genus are *Musica* Bolten 1797, *Chlorosina* Gray 1858, *Volutolyria* Crosse 1877. The genus occurs in the West Indies and West Africa, but not in the Australian region.

Genus LYRIA Gray 1847.

Lyria Gray 1847. *Proc. Zool. Soc. Lond.*, 141.

Genotype: *Voluta nucleus* Lamarck 1811. Tropical seas.

Remarks: *Otocheilus* Conrad 1865 is a synonym.

RECENT.

mitraeformis Lamarck 1804. S.A. (type). W.A., Vict., Tas. = *multicostata* Broderip 1827.
pattersonia Perry 1811. N.S.W. (type), Q., N.A., S. Pac.
kimberi Cotton 1932. S.A. (type) D. 10185.
deliciosa Montrouzier 1859. Q., N. Caledonia (type).
nucleus Lamarck 1844. Q. (type).

TERTIARY.

acuticostata Chapman 1920. Balcombe Bay. 4. 5.
semiacuticostata Pritchard 1896. Table Cape. 5.

Genus HARPEOLA Dall 1907.

Harpeola Dall 1907. *Smith Misc. Coll.* 48, 350.

Genotype: *Voluta anna* Lesson 1832 = *V. costata* Swainson 1849. Moluccas.

Remarks: A synonym is *Harpella* Gray 1858; not *Harpella* Schrank 1802 (Lepidoptera). The genotype is found in the West Indies.

TERTIARY.

harpularia Tate 1888. Muddy Creek, Lower Beds. 4, 5.
gemmata Tate 1888. Muddy Creek, Upper Beds. 2.

Genus TERNIVOLUTA Von Martens 1897.

Ternivoluta von Martens 1897. *Arch. f. Naturg.* 63, 1, 177.

Genotype: *Voluta (Ternivoluta) studeri* von Martens 1897. Queensland.

RECENT.

studeri von Martens 1897. E. Aust., 36 fathoms, Q. (type).

Genus AUSTROVOLUTA gen. nov.

Genotype: *Voluta antiscalaris* McCoy 1874. Fyansford, Vict.

Shell attenuated anteriorly, spire moderately acute; body whorl and spire whorls sharply angulated at the shoulder, which is set with short sharp conical spines corresponding to the sigmoid acute, spaced axial ribs; another corresponding set of short spines is situated just below the suture; axial ribs crossed by numerous spiral sulci with flat intermediate spaces; columellar plaits three or four, slender, widely separate and oblique, the posterior plait distinctly less developed than the others; outer lip thin, smooth; protoconch obtusely rounded, smooth, of one-and-a-half whorls.

Remarks: The genus ranges from the Lower Miocene to the Upper Pliocene. It is most nearly related to the European Tertiary genus *Volutospina* Newton 1906 (genotype *Conus spinosus* Linne), synonyms of which are *Plejona* Bolten (pars) 1898 and *Volutilithes* Swainson 1840, not Swainson 1831 (genotype, *Voluta muricina* Lamarck 1831). The protoconch of the European genotype *V. spinosus* is sharp and small, not swollen at the tip, consists of two or three smooth whorls and has one more whorl than in the Australian genus. This difference certainly separates the Australian genus here described. *V. anticingulata, V. levior, V. persulcata,* and *V. indivisa* may all be variants of *V. anticingulata.*

TERTIARY.

antiscalaris McCoy 1874. Fyansford, Schnapper Point, 1, 4.
levior McCoy 1874. Mount Martha, 4.
antispinosus Tate 1899. Murray Desert 3.
anticingulata McCoy 1874. Bird Rock 4, 5.
agnewi Johnston 1880. Table Cape 5.
indivisa McCoy 1874. Table Cape, 5, = *persulcata* McCoy 1876. Spring Creek 5.

Genus ERICUSA Adams 1825.

Ericusa H. & A. Adams 1825. *Genera Rec. Moll.*, 2, 619.

Genotype: *Voluta papillosa* Swainson 1820. Southern Australia.

Remarks: The protoconch of *E. papillosa* Swainson is shorter and less oblique than that of *E. fulgetrum* though they are basically similar in form. The difference does not warrant generic separation. The genus is well represented in the Miocene. There is a species found in the "Adelaidean" (Pliocene) but no complete specimens are available for the description; it may be *E. ancilloides* Tate. *V. crassilabrum* may be a *Mitra*.

RECENT.

papillosa Swainson 1820. Loc? (type). Tas., S.A., Vict., W.A. 100 fathoms? = *papillaris* Reeve 1849, S.A. (type) = *macquariensis* Petterd 1879, W. Tas. (type).

kenyoniana Brazier 1898. N.S.W., Vict. (type), W.A. 100 fathoms?

fulgetrum Sowerby 1825. Loc.? (type) S.A., W.A., 120 m. W. of Eucla, 120 fathoms. var. *lunisligata* Verco 1912. S.A. (type); var. *punctisligata* Verco 1912. S.A. (type); var. *connectens* Verco 1912. S.A. (type); var. *bicincta* Verco 1912. S.A. (type); var. *tricincta* Verco 1912. S.A. (type); var. *unicincta* Verco 1912. S.A. (type); var. *alba* Verco 1912. S.A. (type); var. *dictua* Verco 1912. S.A. (type).

TERTIARY.

ancilloides Tate, 1889. River Murray Cliffs, 2, 3, 4, 5.
pellita Johnston, 1880. Table Cape. 4, 5.
allporti Johnston, 1880. Table Cape. 5.
ellipsoidea Tate, 1888. Muddy Creek, Lower Beds.
crassilabrum Tate, 1889. Muddy Creek, Lower Beds. 4.
fulgetroides Pritchard, 1895. Muddy Creek, Upper Beds. 2, 3.

Genus MESERICUSA Iredale, 1929.

Mesericusa Iredale, 1929. *Rec. Aust. Mus.*, 17, No. 4, 181.

Genotype: *Mesericusa sowerbyi perspecta* Iredale, 1929. New South Wales.

Remarks: *Mesericusa* has a smaller protoconch than that of *Ericusa* and the tip is exsert also the shell is narrower and differently shaped.

RECENT.

sowerbyi Kiener, 1839. S. Tas. (type). N. Tas., Vict. = *fusiformis* Angas, 1871, Tas. (type).
perspecta Iredale, 1929. N.S.W. (type).

TERTIARY.

halli Pritchard, 1896. Bird Rock, Lower Beds. 5.

Genus COTTONIA Iredale 1934.

Cottonia Iredale 1934. *S. Aust. Nat.*, 15, No. 2, 57.

Genotype: *Scaphella dannevigi* Verco 1912.

RECENT.

nodiplicata Cox 1910. W.A., Rottnest Island (type). = *dannevigi* Verco 1912. W.A. 90 miles west of Eucla, 105–77 fathoms (type).

TERTIARY.

heptagonalis Tate 1889. Murray Cliffs, Morgan. 4.
validicostata Dennant & Kitson 1903. *nom. mut.* = *alticostata* Tate 1889, Muddy Creek, Lower Beds. 3, 4, 5. (preocc.).
atkinsoni Pritchard 1896. Table Cape. 5.
spenceri Pritchard 1896. Table Cape. 5.

Genus PTEROSPIRA Harris 1897.

Pterospira Harris 1897. *Cat. Tert. Moll. Brit. Mus.*, pt. 1, 100.

Genotype: *Voluta hannafordi* McCoy 1874. Muddy Creek.

Remarks: This genus seems closely allied to *Cottonia* judging from protoconch features and even adult shell characters.

RECENT.

roadnightae McCoy 1881. Vict. (type). S.A.

TERTIARY.

hannafordi McCoy 1874. Fyansford. 3, 4, 5.
gatliffi Pritchard 1898. Muddy Creek, Lower Beds. 4.
stephensis Johnston 1880. Table Cape. 5.
wynyardensis Pritchard 1913. Table Cape. 5.
mortoni Tate 1889. Muddy Creek, Lower Beds. 4, 5.
macroptera McCoy 1874. Bird Rock, Geelong. 5.

Genus MAMILLANA Crosse 1871.

Mamillana Crosse 1871. *Journ. de Conch.*, 2, ser. 3, 308.

Genotype: *Voluta mamilla* Gray 1859.

Remarks: The protoconch is exceptionally large and bulbous in this genus. According to Mr. O. Singleton (verbal communication) there is a fossil specimen from Jemmy's Point in the Cudmore collection, closely allied to *M. mamilla* Gray.

RECENT.

mamilla Gray 1859. N.S.W., Tas., Vict., S.A., N.A., Q.

Genus MELO Humphrey 1797.

Melo Humphrey 1797. *Mus. Calonn.*

Genotype: *Voluta diadema* Lamarck 1844. = *V. cithara* Solander 1786. = *V. amphora* Solander 1786.

Remarks: The two species of *Melo* found in Northern Australia, *M. amphorus* and *M. umbilicatus* are separated by the wide mouth, close coronation and sunken spire of the latter species. The S.W. Australian species *M. georginae*, may be slightly different from *M. mucronatus*. A photograph of a newly formed egg capsule of *Melo miltonis* attached to a piece of limestone from the reef at Ceduna, S.A., is reproduced here. Height 220 mm., width 114 mm. No vestige of the protoconch is visible at this stage, but when the embryo is fully developed and on the point of hatching the protoconch is about 26 mm. in length and 16·5 mm. in greatest width. A photograph of a capsule showing the protoconch fully developed was described and figured by the author in the Rec. S. Aust. Mus., 6, No. 1, p. 101, pl. 4, fig. 5, 6, 7, 1937. Further notes were published in the same periodical 1944, 8, No. 1, 143.

RECENT.

amphorus Solander 1786. Q. (The Boring Globe) = *flammeum* Bolten 1798, Indian Ocean. = *diadema* Tryon 1882, Indian Ocean. = *diadema* Lamarck 1844, Indian Ocean. = *cithara* Solander 1786, Indian Ocean.

umbilicatus Sowerby 1825, Q. (type) N.A. = *ducalis* Lamarck 1844, Moreton Bay, Q. (type), N.A.

mucronatus Sowerby 1855. Moreton Bay, Q. (type). N.A. = *georginae* Gray 1834. Swan River (type), S.W.A.

miltonis Gray 1834. Swan River (type). S.W.A., S.A. = *cylindratus* Broderip 1855. S.W.A. (type).

Genus CYMBIOLA Swainson 1831.

Cymbiola Swainson 1832. *Zool. Illust.*, Ser. 2, 2, pl. 19, pl. 87.

Genotype: *Voluta cymbiola* Sowerby 1847. Moluccas.

Remarks: Synonyms are *Aulica* Gray 1847, *Scapha* Gray 1847. *Vespertilio* Klein 1753. *C. scafa* and *C. tissotina* are probably nodular and smooth forms of the same species. The Tertiary species *V. hamiltonensis* included here has a rather large protoconch, and may not be congeneric. McCoy mentions two variants of *V. strophodon*, a shorter and a longer spired form.

RECENT.

deshayesi Reeve 1854. N.Q., N. Cal.
mariaemma Gray 1859. N.W.A. (type) = *grayi* Crosse 1871. N.W.A.
nivosa Lamarck 1844. W.A., Garden Island (type). = *oblita* Smith 1809, W.A.
norrisi Gray 1838. W.A. Depuch Island (type).
pulchra pulchra Sowerby 1825. Q. Great Barrier Reef.
pulchra wisemani Brazier 1871, N.Q. (type). N.E. Aust.
rutila rutila Broderip 1825. N.Q. (type).
rutila inexta Reeve 1849. Louisade, New Guinea.
rutila ruckeri Crosse 1867. Q., New Guinea, Solomon Islands (type).
rossiniana Bernardi 1859. N. Cal.
sophia Gray 1846. N.A. (type). Q.
tissotina Crosse 1867. N.A. (type).
flavicans Gmelin 1791. N.A., Q.
piperita Sowerby 1844. Q., New Georgia, Solomon Islands. = *macgillivrayi* Cox 1873. New Georgia, Solomon Islands. = *ceraunia* Crosse 1880.
imperialis Lamarck 1844. Philippines (type). N.A.?
irvinae Smith 1909. W.A. Rottnest Islands (type).
vespertilio Linne 1766. Ind. Ocean (type), N.A.
nobilis Solander 1786. Polynesia, China, N.A. = *scapha* Gmelin 1788.
scafa Solander 1886. N.A.

TERTIARY.

strophodon McCoy 1876. Fyansford. 3, 4, 5.
weldii. Tenison Woods 1876. Table Cape, 2, 3, 4, 5.
stolida Johnston 1880. Table Cape. 5.
brevispira Pritchard 1913. Table Cape. 5.
intermedia Pritchard 1913. Table Cape. 5.
angustior Pritchard 1913. Table Cape. 5.
macdonaldi Tate 1888. Muddy Creek, Lower Beds. 4.
unicifera Tate 1888. River Murray Cliffs. 3, 4, 5.
hamiltonensis Pritchard 1898. Muddy Creek, Lower Beds. 4.

Genus VOLUTOCONUS Crosse 1871.

Volutoconus Crosse 1871. *Journ. de Conch.*, 19, 306.

Genotype: *Voluta coniformis* Cox 1871.

RECENT.

coniformis Cox 1871. N.W.A., Nichol Bay (type).
bednalli Brazier 1879. N.A. (type).

TERTIARY.

limbata Tate 1888. Blue clays, Schnapper Point. 4.
ralphi Finlay 1930 = *conoidea* Tate 1888. Muddy Creek, Lower Beds. 4 (preocc.), not Renier 1804 or Bosc 1801.

Genus CYMBIOLACCA Iredale 1929.

Cymbiolacca Iredale 1929. *Rec. Aust. Mus.*, 17, No. 4, 181.

Genotype: *Cymbiola complexa* Iredale 1924.

RECENT.

complexa Iredale 1924. Q., N.S.W., N. Cal. = *punctata* Swainson 1823. Not Allan 1818.

Genus CYMBIOLENA Iredale 1929.

Cymbiolena Iredale 1929. *Rec. Aust. Mus.*, 17, No. 6, 181.

Genotype: *Voluta magnifica* Perry.

RECENT.

magnifica Perry 1811. N.S.W. (type).

Genus CYMBIOLISTA Iredale 1929.

Cymbiolista Iredale 1929. *Rec. Aust. Mus.*, 17, No. 4, 181.

Genotype: *Voluta marmorata* Swainson 1822.

RECENT.

marmorata Swainson 1822. Q.
hunteri Iredale 1931. N.S.W. (type).

Genus NOTOPEPLUM Finlay, 1926.

Notopeplum Finlay 1926. *Trans. N.Z. Inst.*, 57, 514.

Genotype: *Scaphella victoriensis* Cossmann 1899. Viet., Muddy Creek.

Remarks: The species of this genus have a shape like *Amoria pallida* Gray and the protoconch, too, is somewhat similar.

RECENT.

translucidum Verco 1896. S.A. (type).

TERTIARY.

victoriensis Crossman 1899. 4. = *politum* Tate 1889. Muddy Creek, Lower Beds. (preocc.).
protorhysum Tate 1889. Adelaide Bore. 5.
saginatum Finlay 1930. Table Cape. 5.
maccoyii Tenison Woods 1877. Table Cape. 5.
balcombensis Finlay 1930. Balcombe Bay. 4.

Genus ZEBRAMORIA Iredale, 1929.

Zebramoria Iredale 1929. *Rec. Aust. Mus.* 17, No. 4, 180.

Genotype: *Voluta zebra* Leach 1814. N.S.W., Q.

RECENT.

zebra Leach 1814. N.S.W., Q.
zebra dampieria Iredale 1914. N.W.A. (type).
zebra lineata Leach 1814. N.A. (type).

Genus RELEGAMORIA Iredale 1936.

Relegamoria Iredale 1936. *Rec. Aust. Mus.*, 19, No. 5, 314.

Genotype: *Relegamoria molleri* Iredale 1936. New South Wales, 85 fathoms.

RECENT.

molleri Iredale 1936. N.S.W., 85 fathoms (type).

Genus AMORENA Iredale, 1929.

Amorena Iredale 1929. *Rec. Aust. Mus.*, 17, No. 4, 180.

Genotype: *Voluta undulata* Lamarck 1804. Vict.

undulata Lamarck 1804. Vict. (type), N.S.W., S.A., Tas., W.A. = *angasi* Brazier 1876. N.S.W. (type).
kingi Cox 1871. King Island, Bass Straits (type). Tas.
slateri Cox 1869. Tas (type).
macandrewi Sowerby 1882. W.A. (type).

TERTIARY.

masoni Tate 1889. Muddy Creek, Upper Beds. 2.

Genus NANNAMORIA Iredale 1929.

Nannamoria Iredale 1929. *Rec. Aust. Mus.*, 17, No. 4, 181.

Genotype: *Nannamoria amicula* Iredale 1929. N.S.W., 50–60 fathoms.

Genus NANNAMORIA ABSIDATA sp. nov.

Pl. 14.

Shell ovately fusiform, rather thin, smooth, shining; protoconch broadly conical, of four smoothly flattened whorls, with an impressed suture; adult whorls three-and-a-half, moderately convex anteriorly; sculpture of curved, slender, rather angular axial costae, crowded on the posterior whorl, interspersed with very fine accremental striae; last whorl slightly ventricose posteriorly, gradually tapering anteriorly but still rather broad at the anterior end; aperture elongate, three times the length of the spire; outer lip bevelled to a thin edge, a little emarginate and ascending at the suture, almost straight medially, patulous anteriorly; canal short, opened, turned to the right, scarcely reverted; columella arcuate towards the front, with four equidistant, equal, oblique plaits.

Height 69 mm., diameter 27 mm. Protoconch, height 5 mm., diameter 5·5 mm.

Loc.: Muddy Creek, Lower Beds.

Remarks: *N. absidata* is related to *N. lirata* Johnston 1880 from Table Cape. The present species is more strongly sculptured and the protoconch has more whorls. The species was figured by Tate 1889 as *N. lirata* Johnston, from a specimen in the Tate Museum.

RECENT.

amicula Iredale 1929. N.S.W., 50–60 fathoms (type).
guntheri Smith 1886. W.A. (type). S.A.
adcocki Tate 1888. S.A. (type).

TERTIARY.

costellifera Tate 1889. Muddy Creek, Lower Beds. 4.
lirata Johnston 1880. Table Cape. 4, 5.
absidata sp. nov. Muddy Creek, Lower Beds. 4.

Genus AMORIA Gray 1855.

Amoria Gray 1855. *Proc. Zool. Soc.*, 64.

Genotype: *Voluta turneri* Gray 1834. W.A.

Remarks: The protoconch of the rare species *A. exoptanda* is of the type found in this species.

Genus AMORIA NEWMANAE sp. nov.

Pl. 13.

Shell rather small in size, fusiform, rather narrow, shoulder not angled but gently curving into the general contour of the shell, fairly solid, smooth and

polished, light cream-coloured, with close wavy, nut-brown axial lines, rather irregular, forming U-shaped loops which in places coalesce, the next line giving in some places an incomplete ringlike pattern; a few odd indistinct blotches form two broken spiral bands on the body-whorl and there is a very narrow series of more distinct but small blotches just below the suture; spine acuminated, rather sharply angled but the protoconch is small, blunt, and polished, the first whorl rather depressed, colour cream stained with brownish-violet, the adult colouration commencing rather abruptly after the first four-and-a-half whorls, aperture rather narrow, polished, light-brown coloured fading to white at the outer lip; columella plaits four, forming a fasciole at the lower portion, where they are produced unto the body whorl.

Height 66 mm., diameter 25 mm.

Loc.: North Western Australia.

Remarks: Holotype. Reg. No. D.14226, S.A. Mus. The species is probably more like *Amoria turneri* than any other species, but it has a peculiar colour pattern. It is less like *Amoria praetexta* which has a tent-like decoration and wider aperture.

RECENT.

pallida pallida Gray 1834. W.A. (type) = *volva* Chemnitz.
pallida turneri Gray 1834. W.A. (type).
pallida damoni Gray 1864. W.A. (type). = *gatliffi* Sowerby 1910. N.A., Port Keats (type), not *gatliffi* Pritchard 1898, a fossil.
pallida elliotti Sowerby 1864. N.A. (type), W.A.
newmanae sp. nov. N.W.A. (type), N.A.
jamrachi Gray 1864. W.A. (type), N.A.
caroli Iredale 1924. Q. = *maculata* Swainson 1882. Not Meuschen 1781.
spenceriana Gatliff 1908. N.Q. (type).
grossi Iredale 1927. Q. (type).
canaliculata McCoy 1869. N.A., Port Denison (type).
praetexta Reeve 1849. N.A. (type).
reevei Sowerby 1858. W.A.? (type). = *hedleyi* Iredale 1914. N.W.A. (type). = *reticulata* Reeve 1843. Not Linne 1767.
exoptanda Sowerby 1849. S.A. (type), S.W.A.

TERTIARY.

macrocephala Finlay 1926. *nom mut.* 3. = *capitata* Tate 1889. Murray Desert, Well Sinking. 3. Not *Voluta capitata* Perry 1811.

Genus NOTOVOLUTA Cotton 1946.

Notovoluta Cotton 1946. *S. Aust. Nat.*, 24, No. 1, 15.

Genotype: *Voluta kreuslerae* Angas 1865. S.A.

RECENT.

kreuslerae Angas 1865. S.A. (type).
verconis Tate 1822. S.A. (type).
occidua Cotton 1946. W.A., Hopetoun, 35 fathoms (type).
thatcheri McCoy 1868. Bampton Reef, New Caledonia (type), Q.. D. 14221.
rossiteri Brazier 1898. Vict. (type), D. 8322.
perplicata Hedley 1902. Q., Great Barrier Reef (type).

TERTIARY.

tateana Johnston 1880. Table Cape. 5.
cathedralis Tate 1888. Muddy Creek, Lower Beds. 4, 5.
pagodoides Tate 1888. Aldinga, Lower Beds. 4, 5.
tabulata Tate 1888. Murray Desert, Well Sinking. 2, 3.
pseudolirata Tate 1888. Muddy Creek, Lower Beds. 4.
cribrosa Tate 1889. Aldinga, Lower Beds. 5.
lintea Tate 1889. Murray Cliffs. 3, 4.
sarissa Tate 1889. Murray Cliffs. 4.
pueblensis Pritchard 1898. Lower Beds, Bird Rock. 5.
sexuaplicata Chapman 1922. Muddy Creek, Clifton Bank. 4.

REFERENCES.

Tate, R., 1888. The Gastropods of the Older Tertiary of Australia. Pt. 1, *Trans. Roy. Soc. S. Aust.*, 10, pp. 91–176.

Tate, R., 1889. The Gastropods of the Older Tertiary of Australia. Pt. 2, *Trans. Roy. Soc. S. Aust.*, 11, pp. 116–174.

Cotton, B. C., 1932. Notes on Australian Mollusca with descriptions of new genera and new species. *Rec. S. Aust. Mus.*, 4, pp. 537–547, fig. 1–9.

Smith, M., 1942. A Review of Volutidae. Published by the Beal-Maltbie Shell Museum, Winter Park, Florida.

Cotton, B. C., 1946. Some Rare Southern Australian Shells. *S. Aust. Naturalist.* 24, No. 1, pp. 13–16.

EXPLANATION OF PLATES.

Plate xiii.

Amoria newmanae sp. nov. N.W.A. (× 0·94).
Cymbiola tissotina Crosse 1867. N.A. (× 0·56).
Amoria praetexta Reeve 1849. N.A. (× 0·94).
Cymbiola nobilis Solander 1786. N.A. (× 0·56).
Amorena kingi Cox 1871. King Island. (× 0·56).
Cymbiolacca complexa Iredale 1924. Q. (× 0·56).
Cymbiola scafa Solander 1786. N.A. (× 0·75).
Cymbiola vespertilio Linne 1766. N.A. (× 0·56).
Cottonia nodiplicata Cox 1910. S.W.A. (× 0·375).
Cymbiola wisemani Brazier 1871. N.Q. (× 0·75).
Cymbiola piperita Sowerby 1825. N.Q. (× 0·75).
Melo umbilicatus Sowerby 1825. N.Q. (× 0·19).
Melo amphorus Solander 1786. N.Q. (× 0·19).
Cymbiolena magnifica Shaw 1801. N.S.W. (× 0·25).
Ericusa kenyoniana Brazier 1898. Vict. (× 0·375).

Plate xiv.

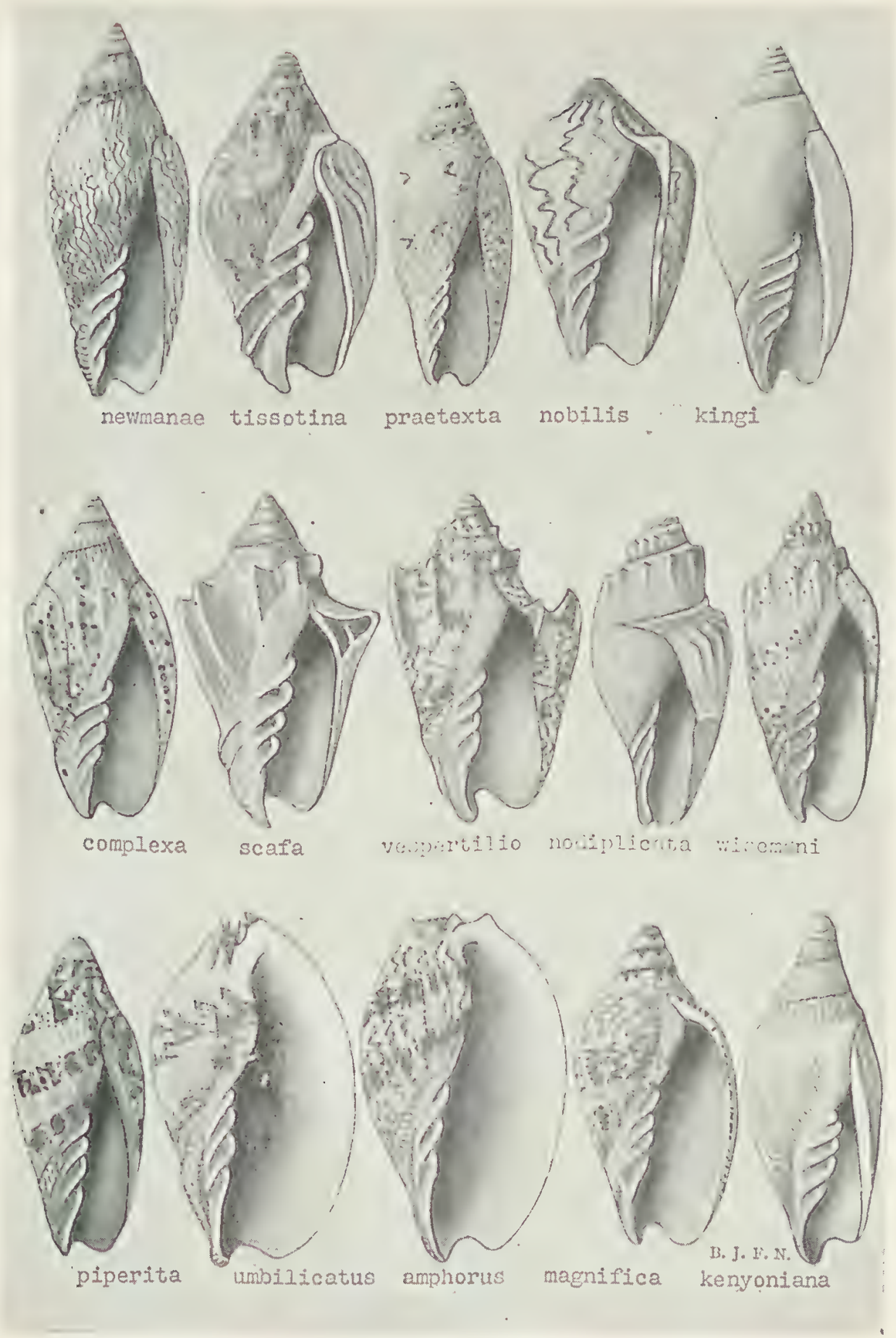
Harpcola harpularia Tate 1888. Muddy Creek, Lower Beds. (× 1·5).
Nannamoria absidata sp. nov., (× 0·75).
Ericusa ancilloides Tate 1889. Murray Cliffs. (× 0·75).
Nannamoria costellifera Tate 1889. Muddy Creek, Lower Beds. × (0·75).
Amorena masoni Tate 1889. Muddy Creek, Upper Beds. (× 0·75).
Notovoluta tatcana Johnston 1880. Table Cape. (× 0·75).
Notovoluta tabulata Tate 1888. Abattoirs Bore. (× 1·2).
Cymbiola weldii Tenison Woods 1876. Table Cape. (× 1·05).
Cottonia alticostata Tate 1889. Muddy Creek, Lower Beds. (× 0·4).
Notovoluta pseudolirata Tate 1888. Muddy Creek, Lower Beds. (× 0·75).
Cymbiola macdonaldi Tate 1888. Muddy Creek, Lower Beds. (× 0·375).
Notovoluta sarissa Tate 1889. Murray Cliffs. (× 0·6).
Pterospira hannafordi McCoy 1874. Fyansford. (× 0·375).
Notovoluta pagodoides Tate 1888. Muddy Creek, Lower Beds. (× 0·75).
Cottonia heptagonalis Tate 1889. Murray Cliffs, Morgan. (× 0·25).

Plate xv.

Austrovoluta antiscalaris McCoy 1874. Fyansford, Schnapper Point. (× 1·46).
Notovoluta cathedralis Tate 1887. Muddy Creek, Lower Beds. (× 0·825).
Pterospira mortoni Tate 1889. Muddy Creek, Lower Beds. (× 0·75).
Ericusa ellipsoidea Tate 1888. Muddy Creek, Lower Beds. (× 0·675).
Austrovoluta anticingulata McCoy 1874. Bird Rock, Lower Beds. (× 1·05).
Mesericusa halli Pritchard 1896. Bird Rock, Lower Beds. (× 0·3).
Notopeplum balcombensis Finlay 1930. Muddy Creek. (× 0·94).
Notovoluta lintea Tate 1888. Murray Cliffs. (× 1·9).
Notopeplum protorhysum Tate 1889. Adelaide Bore. (× 0·97).
Pterospira macroptera McCoy 1874. Bird Rock, Geelong. (× 0·32).
Volutoconus limbata Tate 1888. Blue clays, Schnapper Point. (× 1·57).
Austrovoluta antispinosus Tate 1899. Murray Desert. (× 0·75).
Cymbiola strophodon McCoy 1876. Fyansford. (× 1·4).
Ericusa crassilabrum Tate 1888. Muddy Creek, Lower Beds. (× 5·4).
Volutoconus ralphi Finlay 1930. Muddy Creek, Lower Beds. (× 1·3).

Plate xvi.

Newly-laid egg-capsule of *Melo miltonis Gray*, attached to a piece of reef limestone. Ceduna, S.A. (× 0·7).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tissotina
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nobilis
kingi
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nodiplicata
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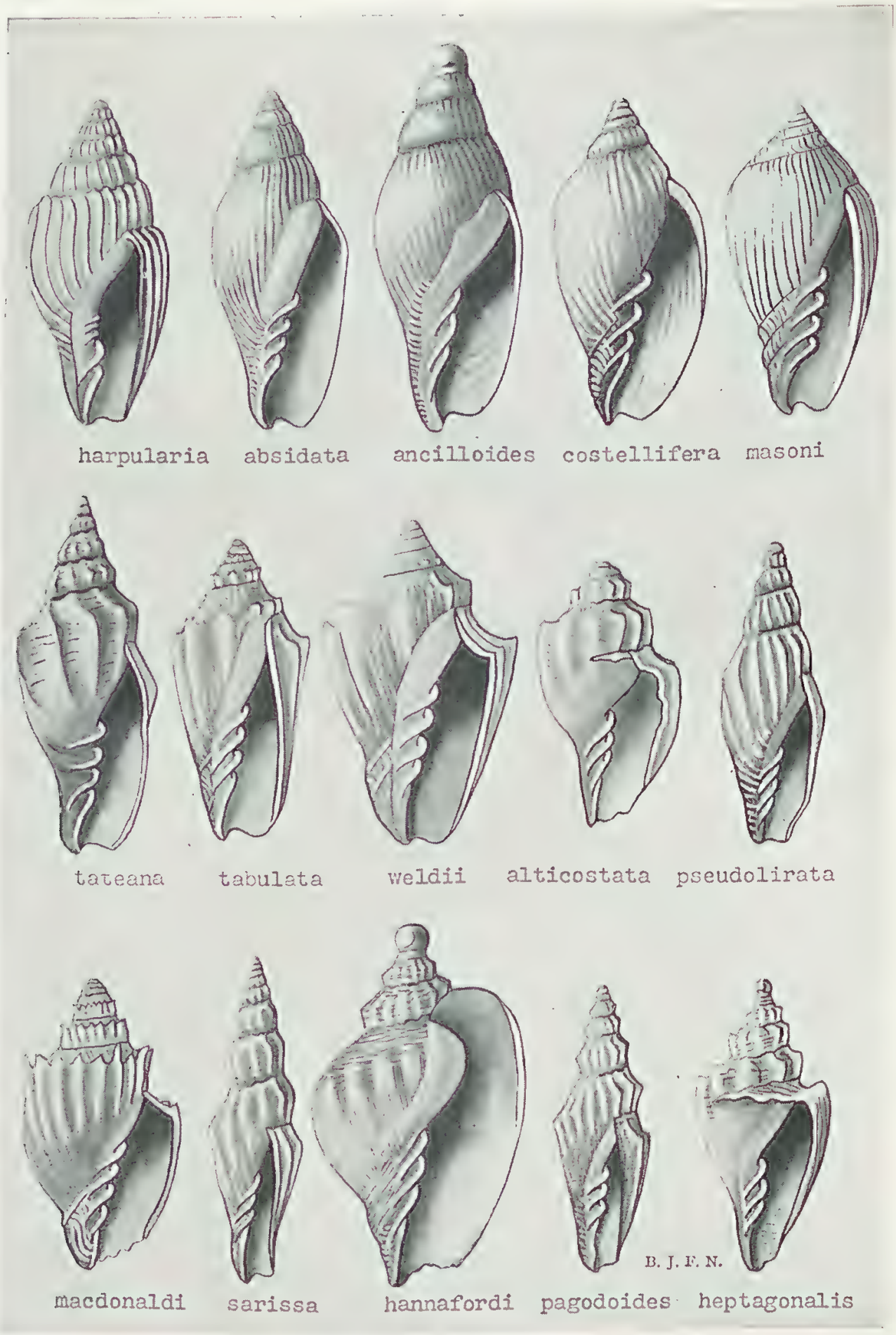
amphorus
magnifica
kenyoniana
B. J. F. N.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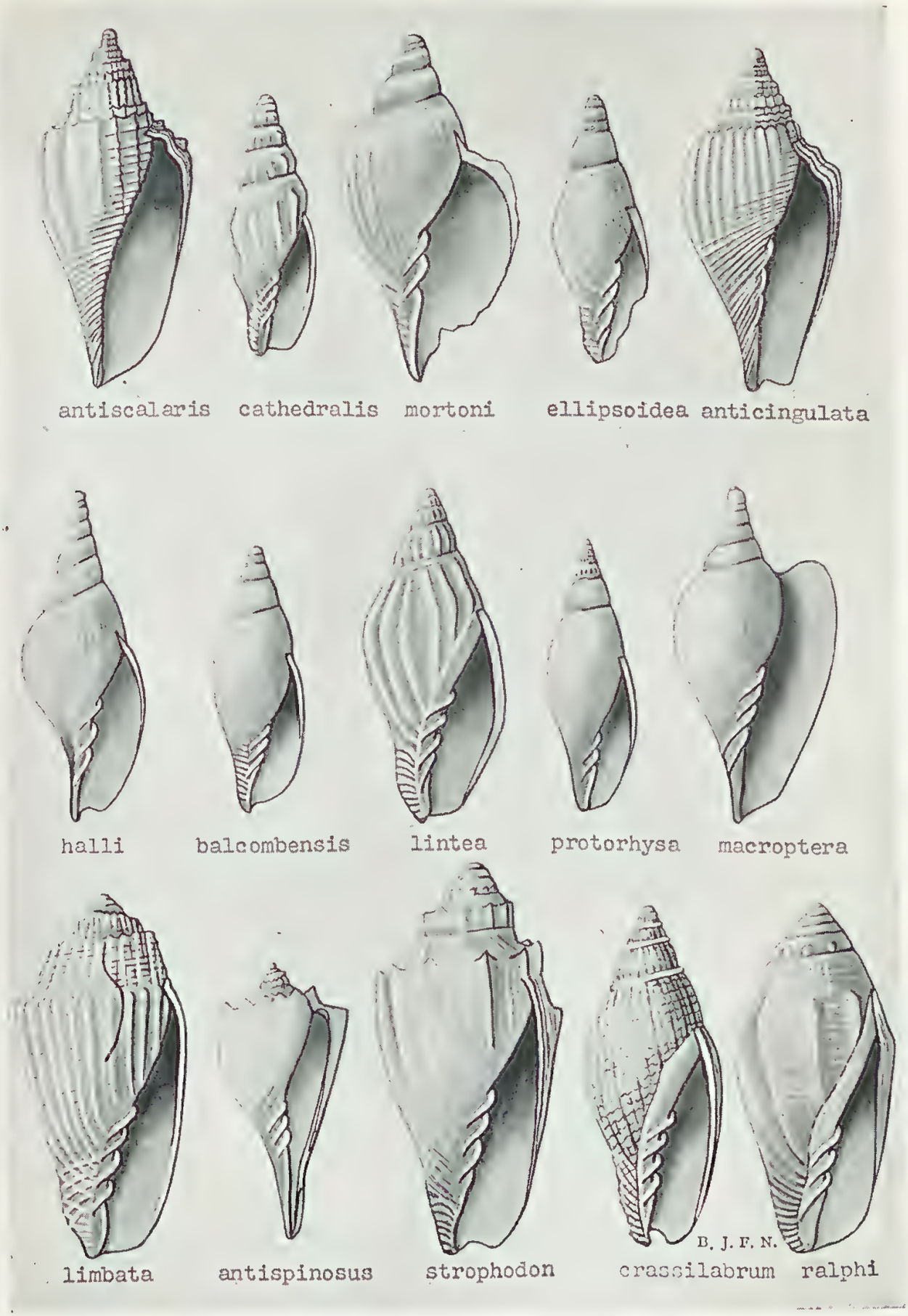
costellifera
masoni
tateana
tabulata
weldii
alticostata
pseudolirata
macdonaldi
sarissa
hannafordi
pagodoides
heptagonalis
B. J. F. N.


antiscalaris
cathedralis
mortoni
ellipsoidea
anticingulata
halli
balcombensis
lintea
protorhysa
macroptera
limbata
antispinosus
strophodon
crassilabrum
ralphi
B. J. F. N.

AUSTRALIAN RECENT AND TERTIARY MOLLUSCA

FAMILY MARGINELLIDAE.

By BERNARD C. COTTON, CONCHOLOGIST, SOUTH AUSTRALIAN MUSEUM.

Plates xvii–xx.

INTRODUCTION.

IN the "South Australian Naturalist" 1944 the author gave a preliminary survey of the genus *Marginella* recording ninety-two Recent species from Australia. Since then C. F. Laseron 1948 has studied the New South Wales fauna and his excellent work has been published in the "Records of the Australian Museum." Opportunities afforded during work on bore material at the Mines Department of South Australia enabled me to examine many Tertiary specimens of this family. Tertiary species are small and most bore specimens are found in good condition. They are, therefore, good indicators for stratigraphic purposes.

Figures of Tate's Tertiary species reproduced here are prepared by Miss B. J. F. Newman from the type tablets in the Tate Museum, University of Adelaide, kindly lent by Sir Douglas Mawson. A number of Table Cape fossils and a magnificent range of Recent exotic species in the May collection, also a selection of Tate's Muddy Creek fossils all in the South Australian Museum provided valuable specimens for study.

From the few references listed at the end of this paper practically all information on nomenclature and descriptions of species can be obtained, and others can be traced in the Zoological Record from the dates given. Many individual localities of species from Southern Australia are recorded in the "South Australian Naturalist." Certain species are figured here, some for the first time and the rest for comparative purposes, since in a difficult family of this nature a good figure is much more satisfactory than the longest description. The animal of *M. mustellina* Angas was described by Hedley in 1916 and that of *M. weedingi* by myself in 1944.

THE GENERA.

The margin shells belong to the family Marginellidae and there are about one thousand specific names recorded, many of them synonyms. Particulars

of the genera belonging to the family are now considered. It is doubtful whether any of the named "genera" other than *Marginella* used in the wide sense are represented in Australia. *Marginella* itself has a dozen "subgenera" and it would be difficult and probably inaccurate to even allot Australian species to any of these subgenera.

Genus PERSICULA Schumacher, 1817.

The genotype is *P. persicula* Linne from Cape Verde Island off West Africa. Other species are found in the West Indies, Pacific Coast of Mexico, Brazil, Mediterranean, Honduras, Borneo and California. *Marginella ovulum* Sowerby, placed in my Group E. and *Marginella deburghi* Adams, *Marginella pulchella* Kiener belonging to Group F. have sometimes been placed in this genus.

Genus RABICEA Gray, 1857.

The genotype is *R. interrupta* Lamarck, from the West Indies. The few species belonging to this genus, regarded as a section of *Persicula* are distinct from any Australian *Marginella.*

Genus GIBBERULA Swainson, 1840.

The genotype is *G. oryza* Lamarck from Senegal. It is probably a subgenus of *Persicula.* The species *Marginella infelix* and *M. angasi* placed in my Group D., have sometimes been placed in this genus.

Genus CYSTICUS Stimpson, 1865.

The genotype is *C. capensis* Stimpson from South Africa. The genus is allied to *Gibberula* and there are no Australian species.

Genus GIBBERULINA Monterosato, 1884.

The genotype is *G. clandestina* Brocchi from West Africa and the Mediterranean. A synonym is *Mervia* Dall 1920, also *Marginellopsis* Bavay 1911. Genotype *M. serrei* Bavay is also closely related. There are no Australian species.

Genus MARGINELLONA Martens, 1903.

The genotype is *M. gigas* Martens. Sombrero Channel, Nicobars, dredged 805 m. This genus probably belongs to the Volutidae.

RECENT SPECIES.

Genus MARGINELLA Lamarck, 1801.

The genotype is *Voluta glabella* Linne 1758 from West Africa. The genotype is a large shell up to two inches in length, smooth, polished, without surface sculpture, spire elevated of about four whorls, colour pattern variegated with a subsutural narrow dark brown band. It ranges down the coast of West Africa, Canary Islands and is a fossil in the late Tertiary of Italy. A synonym of this genus is *Pseudomarginella* Maltzan, 1880. There are a number of "sections" "subgenera," etc., which are here listed with the type species and its locality following.

Canalispira Jousseaume, 1875. *C. olivellaeformis* Jousseaume, West Africa.
Crystospira Hinds, 1844. *C. quinqueplicata* Lamarck. Bay of Bengal.
Glabella Swainson, 1840. = *Prunum* H. & A. Adams, 1853. = *Egociena* Jousseaume, 1875. *G. prunum* Gmelin. West Indies.
Closia Gray, 1857. *C. sarda* Kiener. Ceylon.
Bullata Jousseaume, 1875. = *Volutella* Swainson, 1820, not Perry, 1811, *B. bullata* Born. Brazil.
Hyalina Schumacher, 1817. = *Neovolvaria* P. Fischer, 1883. *H. pallida* Linne. West Indies.
Balanetta Jousseaume, 1875. *B. baylei* Jousseaume (error for *baylii* 1875). Loc?
Volvarina Hinds 1844. *V. triticea* Lamarck. Senegal.
Serrata Jousseaume, 1875. *S. serrata* Gaskoin. Mauritius.
Eratoidea Weinkauff, 1878. *E. margarita* Kiener. West Indies.
Faba P. Fischer 1883. *F. faba* Linne. Senegambia.

Australian species have been placed in some of these "genera", "subgenera" or "sections" but no satisfactory classification has so far been formulated. As in my previous paper I separate the Australian *Marginella* species into "Groups." This method of classification seems to be the only solution and it has the approval of other Conchologists. Mr. C. F. Laseron, 1948, writes: "Cotton in his paper has used such groups as a guide to the student of local species, and that is all that is necessary, at least until our knowledge of their anatomy and life history is much further advanced." Most earlier Tertiary species of *Marginella* both European and Australian seem to belong to the Group having the triangular shape and laterally expanded outer lip.

Four new Recent species are here described.

MARGINELLA NEWMANAE sp. nov.

Pl. xx.

Holotype. W.A. Esperance. Reg. No. D. 14229 S.A. Museum. Shell large, pyriform to subovate, cream colour; columella convex above, slightly concave

below; plaits seven small, the lower two stronger than the others; outer lip thickened, curved, rising a little above the level of the spire, finely denticulate anteriorly; aperture narrow. Height 9 mm., diameter 5 mm.

Loc. Beachport 110 fathoms, 150 fathoms, 200 fathoms, Cape Jaffa 130 fathoms, Neptune Islands 104 fathoms, Gulf St. Vincent 14 fathoms, Cape Borda 60 fathoms, W.A., forty miles west of Eucla, 120 fathoms, 72 fathoms, Esperance.

Remarks. More pyriform than *M. porcella* and with more columella plaits, and the outer lip is very finely denticulate anteriorly.

MARGINELLA BACA sp. nov.

Pl. xx.

Holotype. Tas., Cape Pillar 100 fathoms. Reg. No. D. 14227 S.A. Museum. Rather narrowly ovate, fairly thin, smooth, lustrous white; spire short, apex large, covered with a pad of enamel; mouth long and narrow a little broader anteriorly than posteriorly; outer lip thin but a little thickened within; columella with three plaits. Height 4·3 mm., diameter 2·5 mm.

Remarks. As mentioned by Laseron this Tasmanian species is quite distinct from *M. agapeta*. *M. baca* is narrower and more fragile, but it belongs to the same group as *M. agapeta*.

MARGINELLA SICA sp. nov.

Pl. xix.

Holotype. W.A., Eucla, 200 fathoms. Reg. No. D. 14230 S.A. Museum. Shell small, narrow, pyriform, smooth, shining, white; spire rather exsert, whorls four, body whorl angled at the shoulder, sharply tapering anteriorly; columella almost straight with four, strong, spaced plaits; outer lip strongly thickened and widely reflected, obscurely irregularly denticulate on the inner edge; aperture long and narrow, the space between the outer lip and columella remaining the same for the entire length; suture simple. Height 5 mm., diameter 2·9 mm.

Loc. W.A., Eucla 72, 80, 100 and 200 fathoms, S.A., Newland Head 104 fathoms, Beachport 110 fathoms.

Remarks. The shell is like a minature *M. vercoi* but it has simple sutures, not emarginate as in that species, and the outer lip is obsoletely denticulate and has not the six regular denticles seen on the outer lip of *M. vercoi*.

Pl. xx.

MARGINELLA PATRIA sp. nov.

Holotype. W.A., Hopetoun, 35 fathoms. Reg. No. D. 14228, S.A. Museum. Shell small, narrowly biconic, smooth, shining, white; spire short; whorls three, body whorl shouldered, tapering very gradually anteriorly; aperture narrow; outer lip moderately thickened, very finely denticulate; columella with four weak plaits. Height 4 mm., diameter 2·3 mm.

Loc. W.A., Hopetoun, 35 fathoms, S.A. Neptunes 104 fathoms, Cape Borda 55 fathoms.

Remarks. The species resembles *M. caducocincta* but it is narrower, has weaker columella plaits, no colour bands and the outer lip is very finely denticulate. There is a tendency to develop accremental striae which are visible with the × 10 lens. On examining specimens of *M. caducocincta* cotypes from Tasmania it seems probably from the fact that some are narrower and without colour bands that *M. patria* occurs there, too. The Western Australian species here described was originally identified as *M. caducocincta*.

SUMMARY OF RECENT SPECIES.

GROUP A.

Shell with prominent spire, smooth, not colour banded, angled at the shoulder or convex. Typical species, *Marginella muscaria* Lamarck.

M. muscaria Lamarck 1822. Tas., Maria Island (type). Vict., N.S.W. The largest species of this group.

M. johnstoni Petterd 1884. Tas., N.E. Coast (type). Vict., N.S.W., S.A., beach to 55 fathoms. The species lives in shallow water and is fairly common, rarer dredged. Smaller and less strongly developed features than *M. muscaria.*

M. tasmanica Tenison Woods 1875. Tas., Long Bay (type). Vict., N.S.W. Smaller and narrower than *M. muscaria.*

M. tridentata Tate 1878. S.A., Aldinga (type), beach down to 300 fathoms. W.A., beach down to 72 fathoms. Narrow conical shape, three plaits, denticulated outer lip.

M. mixta Petterd 1884. Tas., South and Eastern Coasts (type). Separable from *M. tridentata* by the lack of denticulations on the outer lip, more delicate yellowish brown shell.

M. pygmaeoides Singleton 1937. Vict., Port Phillip (type). Tas., S.A., beach to 22 fathoms.

M. schoutanica May 1913. Tas., three miles east of Schouten Island, 40 fathoms (type). Viet., N.S.W., S.A., 62 to 130 fathoms. Narrower than *M. pygmaeoides* with four strongly ascending plaits reaching half the way up the columella.

M. consobrina May 1911. Tas., seven miles east of Cape Pillar, 100 fathoms (type). Outer lip convexly curved, four narrow plaits, upper one thin, almost invisible from the front.

M. vercoi May 1911. Tas., seven miles east of Cape Pillar, 100 fathoms (type). Broadly shouldered over the aperture, rounded whorls, columella excavate and bearing four plaits, smaller and wider spaced as they ascend, inner edge of outer lip with six denticles near the middle of its length.

M. sica sp. nov. W.A., Eucla, 80 fathoms. Like a miniature *M. vercoi.*

M. inconspicua Sowerby 1846. N.S.W., Ballina (type). Tas., Viet. Recognised by J. R. Le B. Tomlin as belonging to the Sydney fauna. Smaller and shorter spired than *M. pygmaeoides.* There are three obscure pale brown spiral colour bands on good specimens. *M. inconspicua* Nevill 1874, Mauritius, is a different species and it is correctly named *M. nevilli* Jousseaume 1875.

M. victoriae Gatliff and Gabriel 1908. Viet., Western Port, dredged (type). N.S.W. Small, white, shining smooth, much smaller than *M. pygmaeoides.*

M. translucida Sowerby 1846. N.S.W. (type?). Larger than *M. pygmaeoides.* A synonym is *M. volutiformis* Reeve 1865. N.S.W. (type).

M. alta Watson 1886. Qld., Raine Island, Cape York, 155 fathoms (type). Larger and narrower than *M. valida,* mouth wider.

M. carinata Smith 1891. N.S.W., off Sydney 410 fathoms (type). Angle of the whorls carinate.

M. fusiformis Hinds 1844. East Indies, Strait of Malacca, 17 fathoms (type) Qld. Long, narrow and fusiform.

M. humerica Laseron 1948. N.S.W., Port Macquarie, 12 fathoms (type). Close to *M. translucida,* but *M. humerica* is larger and has a larger aperture and more prominent shoulder.

M. punicea Laseron 1948. N.S.W., Jervis Bay (type). The species seems close to *M. tasmanica* but the outer lip is less prominent at the shoulder.

M. pipire Laseron 1948. N.S.W., Twofold Bay, 60 fathoms (type). Somewhat intermediate in shape between *M. punicea* and *M. tasmanica.*

M. quinqueplicata Laseron 1948. N.S.W., Twofold Bay, 5 fathoms (type). This species resembles *M. turbinata* but has five plaits.

GROUP B.

Shell with prominent spire, axial plicae on the shoulder of the whorls, which are angled or convex above. Typical species *Marginella formicula* Lamarck. *"Prunum"* H. & A. Adams 1853 is of this shape.

M. formicula Lamarck 1822. Tas., Maria Island (type). Vict. Spire exsert whorls angled, columella four plaited and inner lip smooth, plicate body and spire whorls.

M. georgiana May 1915. Tas., Southport, near George III. Reef, 15 fathoms (type). Differs from *M. formicula* in the more delicate, much narrower shell, much less strongly axially plicate, and longer in the spire.

M. praetermissa May 1916. Tas., East Coast (type). Vict. Bigger and thicker than *M. formicula,* axial plicae are less developed. May's cotypes are from Eagle Hawk Neck.

M. leia Cotton 1944. S.A., Beachport, 150 fathoms (type). This species is smaller than *M. pattisoni* and has the appearance of being perfectly smooth and polished in the typical form, though under × 10 magnification almost obsolete axial plications may be discerned, while in the other extreme form the plications are just visible to the naked eye.

M. turbinata Sowerby 1846. N.S.W., Middle Harbour, Port Jackson (type), beach to 35 fathoms. Tas., Vict. Slightly plicated on the shoulder, turbinate in shape, outer lip thick, smooth, angulated posteriorly. Angas located the species as from the above type locality. On the back of the type tablet of *M. turbinata* in the British Museum is *"M. albina* Gaskoin" and that name is regarded as a synonym though Gaskoin incorrectly gave N.W. Australia as the type locality.

M. pattisoni Cotton 1944. S.A., Encounter Bay (type), alive in shallow water. This species differs from *M. turbinata* in being more pyriform, wider, white in colour and smaller.

M. pusilla Laseron 1948. N.S.W., Twofold Bay, 60 fathoms (type). Smaller than *M. turbinata* but approaching *M. pattisoni* which is a somewhat larger, shallower water species.

GROUP C.

Shell with very long spire giving a biconic shape, smooth, colour banded, plaits three or four on the lower half or middle of the columella. Typical species *Marginella maugeana* Hedley.

M. maugeana Hedley 1915. Tas., seven miles east of Cape Pillar, 100 fathoms (type). N.S.W. Narrower than *M. mayi* with weaker, closer plaits situated more towards the middle of the columella. *M. maugeana* is a new name for *M. gracilis* May 1911, not Adams 1850.

M. gabrieli May 1911. Tas., seven miles east of Cape Pillar, 100 fathoms (type). Vict., S.A. beach to 40 and 150 fathoms. N.S.W. Small, with narrow orange bands.

M. caducocincta May 1916. Tas., Thouin Bay, 10 fathoms (type). Vict. Not typical of the group, but it is more pyriform and shorter spired. Faintly colour banded or unicoloured. S.A. and W.A. specimens are in poor condition and their identification is doubtful.

M. lodderae May 1910. Tas., seven miles east of Cape Pillar, 100 fathoms (type). S.A. 100 fathoms to 104 fathoms. W.A. Fusiform, spire long.

M. dentiens May 1911. Tas., seven miles east of Cape Pillar, 100 fathoms (type). More cylindrical in shape than *M. lodderae,* inner lip denticulate.

M. kemblensis Hedley 1903. N.S.W., Port Kembla, 63 to 75 fathoms (type). Tas. The tall spire and the tooth on the outer lip distinguish this species. Some are faintly three banded with pale brown.

M. jaffa Cotton 1944. S.A., Cape Jaffa, 130 fathoms (type). S.A., 110, 150, and 200 fathoms. W.A. This species differs from *M. kemblensis* in having a wider and longer aperture, and is less strongly developed in all respects. A macromorph from the type locality compares in size with the adult *M. kemblensis* but the distinguishing features mentioned are still present in this specimen.

M. allporti Tenison Woods 1876. Tas., Long Bay, D'Entrecasteaux Channel (type). Vict. S.A., dredged 5 fathoms to 200 fathoms. W.A. More convex shape than *M. kemblensis,* thicker shell, and shorter spire. Orange banded, and a tooth in the inner lip. The species was listed previously from Cape Wiles only in S.A., and not at all from W.A.

M. mayi Tate 1900. Tas., Frederick Henry Bay (type). N.S.W., Vict., S.A., 15 fathoms to 300 fathoms. W.A. South Australian specimens are translucent horn coloured in life, spire one-third the length of the shell, accremental striae visible, and rust coloured colour bands. The length and breadth vary, and the outer lip may be smooth or finely denticulate.

M. walkeri Smith 1899. Baudin Island and Holothuria Banks, N.W.A. (type). Long and biconical, spire long, four plaits on the columella, outer lip denticulate.

M. patria sp. nov. W.A., 35 fathoms, Hopetoun. S.A. Related to *M. caducocincta* but narrower and having weaker columella plaits and no colour bands.

M. cuneata Laseron 1948. N.S.W., Twofold Bay, 5 fathoms to 20 fathoms (type). This species is most nearly related to *M. jaffa* but is larger and has no tooth on the inside edge of the outer lip margin.

GROUP D.

Shell with very short spire, subovate, smooth unicoloured. Typical species *Marginella olivella* Reeve 1865.

M. olivella Reeve 1865. N.S.W., Port Jackson (type). Shell narrow with nearly straight sides, shoulder at top of aperture rather square.

M. connectans May 1911. Tas., seven miles east of Cape Pillar, 100 fathoms (type). Vict. S.A., 55 fathoms to 104 fathoms. Somewhat cylindrical in shape and intermediate between *M. shorehami* and *M. angasi.* Two specimens have been picked out from the Verco dredgings.

M. freycineti May 1916. Tas., Thouin Bay, 40 fathoms (type). Vict. S.A., 40 fathoms to 200 fathoms. Smaller than *M. connectans,* less cylindrical in shape, longer spire and three instead of four plaits on the columella.

M. incerta May 1920. Tas., Thouin Bay, 40 fathoms (type). Differs from *M. freycineti* in the longer spire, more curved columella, with only two plaits and the broader though similar sized shell.

M. agapeta Watson 1886. N.S.W., Port Jackson, 35 fathoms (type). Tas. Vict. Larger and narrower than *M. freycineti,* but having three plaits. There are two specimens labelled "Port Jackson" in the S.A. Museum collection. They are typical.

M. eucla Cotton 1944. W.A., eighty miles west of Eucla, 80 fathoms (type), Hopetoun. S.A., 10 fathoms to 200 fathoms. Smaller than *M. agapeta,* more delicate, three subequal plaits on the columella.

M. altilabra May 1911. Tas., ten miles east of Schouten Island, 80 fathoms (type). S.A., 40 fathoms to 200 fathoms. Narrower anteriorly than *M. stilla,* lip angle very high and great forward curve, weaker plaits and smooth outer lip margin. (Hedley as *M. stilla* from S.A., Cape Wiles, 100 fathoms).

M. stilla Hedley 1903. N.S.W., Port Kembla, 63 fathoms to 75 fathoms (type). Vict. The outer lip curves out from the body of the shell and does not project at an angle as in *M. altilabra.*

M. diplostreptus May 1916. Tas., Port Esperance 24 fathoms. (Type *M. biplicata* Tate and May 1900). S.A., 10 fathoms to 100 fathoms. Vict., W.A. Typically with two plaits at the posterior end of the columella. S.A. specimens, like those recorded from Black River Beach, North-East Tasmania, near Circular Head, have a tendency to develop a third plait, which is weak and posterior to the other two.

M. subbulbosa Tate 1878. S.A., Wauralte, West Coast (type). S.A., beach to 200 fathoms. N.S.W., W.A., Vict. Consistently smaller and more rotund than *M. beddomei.*

M. beddomei Petterd 1884. Tas., South Coast (type). N.S.W. This common Eastern Tasmanian shell has been confused with *M. subbulbosa.* It is lirate within the aperture.

M. strangei Angas 1877. N.S.W., Sow and Pigs Reef, Port Jackson (type). Vict. Shorter than *M. subbulbosa,* with strong plaits on the columella and a thickened outer lip which is not denticulate.

M. subauriculata May 1916. Tas., Thouin Bay, 40 fathoms (type). Vict. S.A., 40 fathoms to 150 fathoms. W.A. Short and broad, very variable posterior angle of the outer lip produced a little posteriorly, spire minute, six plaits on the columella. Cape Pillar shells are larger, while S.A. specimens are narrower, showing a little more spire.

M. lubrica Petterd 1884. Tas., Brown's River 6 fathoms (type). Outer lip somewhat convex, two plaits.

M. angasi Crosse 1870. N.S.W., Port Jackson (type). Tas. Vict. Slightly trigonal in shape, plaits four to seven, more developed anteriorly, weaker posteriorly. Synonyms are *M. simsoni* Tate & May 1900, Tas., Long Bay, 7 fathoms, and *M. minima* Petterd 1884, Tas. There is also an elongate variant of the *M. simsoni* in Tasmania.

M. shorehami Pritchard and Gatliff 1899. Vict., Shoreham Beach, Western Port Bay (type). S.A., 10 fathoms to 110 fathoms. W.A. Narrower than *M. angasi,* variable. Plaits in the adult number from two to thirteen.

M. ringens May 1919. Tas., Kelso, Tamar Heads (type). Larger aperture and broader than *M. angasi,* outer lip denticulate.

M. obesula May 1919. Tas., Frederick Henry Bay (type). Differing from *M. lubrica* in the rounder shell, sharper spire and denticulate outer lip. It may be only a variant.

M. branchia Watson 1886. Qld, Raine Island, Torres Strait, 155 fathoms (type). Somewhat like *M. freycineti* May 1916 but with four plaits.

M. pachia Watson 1886. Qld., Raine Island, Torres Strait, 155 fathoms (type). Resembles *M. angasi* but shorter with a more curved mouth.

M. elliottae Cotton 1944, *nom. nov.* for *M. denticulata* Tate 1878, not Link 1807 nor Conrad 1830. S.A., Wauralte, West Coast (type loc.). S.A., beach to 300 fathoms. Small. Less trigonal in shape than *M. angasi,* denticulate outer lip, four plaits.

M. infelix Jousseaume 1875. N.S.W. (type). Vict. Shell broader than *M. olivella* and somewhat rounded. A synonym is *M. simplex* Reeve 1865 Aust. (type) not Edwards 1852.

M. procella May 1916. Tas., South East, Storm Bay, 24 fathoms (type). Vict. There is a sinistral specimen in the S.A. Museum collection. This Tasmanian species is smaller and differently shaped from *M. infelix* or *M. olivella.*

M. newmanae sp. nov. W.A., Esperance (type). S.A., 14 to 200 fathoms. The species is described above.

M. frequens Laseron 1948. N.S.W., Sydney, 30 to 50 fathoms (type). Smaller, whiter than *M. strangei.*

M. binivitta Laseron 1948. N.S.W., Cape Jervis Bay (type). Has a still higher and more expanded aperture than *M. antilabra* May.

M. sinuata Laseron 1948. N.S.W., Point Halliday (type). Related to *M. frequens* but *M. sinuata* has stronger and more widely spaced columella plaits.

M. sinapi Laseron 1948. N.S.W., Sow and Pig Reef (type). Has a narrower aperture than *M. subbulbosa.*

M. parsobrina Laseron 1948. N.S.W. Cookhaven (type). Differs from *M. sinapi* in having a narrow sloping shoulder at the top of the aperture.

M. nielseni Laseron 1948. N.S.W., Bateman Bay, 25 to 60 fathoms (type). Resembles *M. flindersi* Pritchard & Gatliff 1899 but the present species has three instead of two columella plaits.

M. melania Laseron 1948. N.S.W., North Harbour, Port Jackson (type). The animal is black, not bright red as in *M. angasi* which the shell features recall, except that in *M. melania* the shoulder of the aperture is a little higher.

M. baca sp. nov. Tas., Cape Pillar 100 fathoms (type). Described above. The species is narrower and more delicate than *M. agapeta* from N.S.W.

GROUP E.

Shell with depressed spire, outer lip produced beyond or level with the posterior end of the body of the shell. Typical species *Marginella tomliniana* May.

M. tomliniana May 1917. Tas., Thouin Bay, 40 fathoms (type). Long and narrow, outer lip extending well posteriorly, spire hidden. New name for *M. auriculata* May 1916.

M. indiscreta May 1911. Tas., Cape Pillar, 100 fathoms (type). S.A., 55 fathoms. Outer lip more produced posteriorly than in *M. cratericula.*

M. cratericula Tate and May 1900. Tas., D'Entrecasteaux Channel, 10 fathoms (type). N.S.W., Vict., S.A., 35 fathoms to 100 fathoms. Outer lip almost level with top of shell posteriorly.

M. concamerata May 1918. Tas., Frederick Henry Bay (type). Columella with six plaits, outer lip not produced beyond the body of the shell posteriorly, spire hidden. New name for *M. albomaculata* May 1911, not Schluter 1838.

M. ovulum Sowerby 1846. Australia (type *M. pisum*). N.S.W., Port Jackson (type). Qld. Shells from Port Jackson and Brisbane are wider and more oval shaped than *M. petterdi.* Angas in 1867 recognized this species, as from N.S.W., and Port Jackson is here accepted as the type locality. Syn. *M. pisum* Reeve 1865.

M. petterdi Beddome 1883. Tas., Kelso Bay, Tamar River, 17 fathoms (type). S.A., 10 fathoms to 200 fathoms. Vict., W.A. Narrower than *M. ovulum* and tendency to denticulation of the outer lip. Syn. New name for *M. cypraeoides* Tenison Woods 1878, not Anton 1839, *M. tenisoni* Pritchard 1900.

M. minutissima Tenison Woods 1876. Tas., Long Bay, D'Entrecasteaux Channel (type). N.S.W. Minute, oval with three plaits. Syn. *M. pumilio* Tate and May 1901, new name for *M. minutissima,* not Michelin (Ubi?).

M. thouinensis May 1916. Tas., Thouin Bay, 40 fathoms (type). S.A., 55 fathoms. Wider than *M. minutissima,* nine plaits.

M. multidentata May 1920. Tas., D'Entrecasteaux Channel, 10 fathoms (type). Shorter, wider aperture and more numerous plaits than *M. thouinensis,* denticulate outer lip.

M. alternans Pritchard and Gatliff 1899. Vict., Shoreham Bay, Western Port (type). S.A., 10 fathoms to 110 fathoms. N.S.W. Minute, oval, numerous plaits.

M. inaequidens May 1913. Tas., Cape Pillar, 100 fathoms (type). S.A., 10 fathoms to 110 fathoms. Two plaits, the upper very weak.

M. bucca Tomlin 1916. Tas. (type probably North). Ovoid, one plait. Syn. *M. ovulaeformis* Tate and May 1900, not Orbigny 1842, *M. ventricosa* Hedley 1903, not Fischer 1807.

M. cymbalum Tate 1878. S.A., Aldinga Bay (type), 10 fathoms to 150 fathoms. Vict., Tas., W.A. Something like *M. bucca* in shape but larger and having six anterior stout plaits and six weaker ones following on posteriorly.

M. flindersi Pritchard and Gatliff 1899. Vict., Shoreham Beach, Western Port (type). S.A., 10 fathoms to 62 fathoms. Narrow, with two plaits, and sometimes a rudimentary third plait posteriorly.

M. cylchnella May 1918, new name for *M. microscopica* May 1911, not Tapparone-Canefri 1887. Tas., Cape Pillar, 100 fathoms (type). Minute, very narrow, with three plaits.

M. erma Cotton 1944. Tas., Cape Pillar, 100 fathoms (type). A peculiar ovoid species with five plaits diminishing posteriorly. It is a wider shell than that of *M. thouinensis.*

M. nympha Brazier 1894. N.S.W., Green Point, Sydney (type). Vict. Similar to *M. minutissima,* but with four plaits.

M. halli Pritchard and Gatliff 1899. Vict., Shoreham Beach, Western Port (type). Has the outer lip projected posteriorly, like *M. cymbalum.*

M. problematica Gatliff and Gabriel 1916. Vict., Western Port 8 to 10 fathoms (type). S.A. Separated from *M. halli* by the flattened summit and more triangular shape, and from *M. inaequidens* by the less cylindrical contour, solidity and disposition of the stronger plaits.

M. amphora Laseron 1948. N.S.W., Point Halliday, 8 to 10 fathoms (type). This species differs from *M. multidentata* in having a broad, nearly truncate top of the body whorl which in *M. multidentata* is greatly restricted.

M. multiplicata Tate and May 1900. Tas. (type). N.S.W. This is separable from *M. alternans,* having a different shape.

M. anxia Hedley 1909. Qld., Hope Island (type).

M. stiria, nom. mut. This name is here substituted for *M. rotunda* Laseron 1948 described from N.S.W., Cookhaven, 30 to 35 fathoms, pre-occupied by the name *M. rotunda* May 1922 for a fossil from Table Cape. The species is somewhat like *M. ovulum,* but is less than half the size and broader.

GROUP F.

Shell long and narrow, cylindrical, with short spire and typically colour banded. Typical species *M. mustellina* Angas.

M. mustellina Angas 1871. N.S.W., Sow and Pigs Reef, Port Jackson (type). Tas. (type *M. pellucida*), Blackman Bay (type *M. stanislas*). Vict. Narrow and colour banded. The edge of the outer lip is weakly denticulate anteriorly on the specimen figured. Syn. *M. stanislas* Tenison Woods 1877. *M. stanislaus* Tryon 1883 error for *M. stanislas* Tenison Woods 1877. *Erato pellucida* Tenison Woods 1877.

M. vincentiana Cotton 1944, for *M. albida* Tate 1878, not Lamarck 1822. S.A., Marino (type), beach to 200 fathoms. Tas., 100 fathoms, off Cape Pillar. W.A. Differs from *M. mustellina* in having the spire more covered and in being unicoloured, smaller, five plaited, and showing regular accremental striae.

M. hedleyi May 1911. Tas., Cape Pillar, 100 fathoms (type). Larger than *M. mustellina,* wider and orange banded.

M. columnaria Hedley and May 1908. Tas., Cape Pillar, 100 fathoms (type). S.A., 12 fathoms to 100 fathoms. W.A. Elongate and narrow, three plaits.

M. caledonica Jousseaume 1877. New Caledonia (type). Somewhat resembling *M. columnaria.*

M. pericalles Tomlin 1916 nom. nov. for *M. guttula* Reeve 1865 (type loc.?) not Sowerby 1837. *M. guttula* Reeve is listed from Queensland by Hedley, but I have not seen specimens from Australia. It seems to be allied to *M. mustellina.*

M. philippinarum Redfield 1846, nom. nov. for *M. avena* Sowerby 1846, not Kiener 1834. Philippines, Island Bolhol (type). W.A., N.W., Holothuria Banks. A long, narrow banded species.

M. pulchella Kiener 1830 (type loc.?) W.A., Cape Lewin (type *M. fulgurata*). Qld., S.A., beach to 130 fathoms. Longitudinal orange zig-zag lines. Common in W.A. Syn. *M. fulgurata* Hedley 1911.

M. deburghi Adams 1864. W.A., Swan River (type), beach. A large and distinctive species, white with larger and smaller chestnut spots in alternate rows.

M. occidua Cotton 1944. W.A., Albany (type), beach to 22 fathoms. This distinctive Australian species has been incorrectly labelled *M. navicella* Reeve, *M. rubella* Adams, *M. obscura* Reeve.

M. haswelli Laseron 1948. N.S.W., 22 miles east of Narrabeen, 80 fathoms (type). Near to *M. occidua,* but *M. haswelli* is larger and has a finely denticulate inner margin of the outer lip.

GROUP G.

Shell with short spire, triangular, outer lip laterally expanded posteriorly, forming a right angle. Typical species *Marginella geminata* Hedley.

M. geminata Hedley 1912. N.S.W., Cape Byron (type). Tas., Vict. Triangular in shape.

M. gatliffi May 1911. Tas., Schouten Island, 40 fathoms (type). Shorter and smaller than *M. geminata.*

M. malina Hedley 1915. N.S.W., Narrabeen, 80 fathoms (type). Small, thin, glossy, subtriangular.

M. brazieri Smith 1891. N.S.W., off Sydney, 410 fathoms (type). Less triangular than *M. gatliffi.*

M. whani Pritchard and Gatliff 1900. Vict., Port Fairy (type). S.A., 55 fathoms. N.S.W. S.A., 55 fathoms. Outer lip denticulate.

M. ochracea Angas 1871. N.S.W. (type), Port Jackson (type *M. metcalfei*). Triangular, sharp spire, four plaits. Synonym *M. metcalfei* Angas 1877.

M. borda Cotton 1944. S.A., Cape Borda, 55 fathoms (type), 17 fathoms to 130 fathoms. W.A. A more solid shell than *M. ochracea,* with longer spire and smooth outer lip.

M. australis Hinds 1844. W.A., North West (type). Orange, brown, lip and aperture orange. More solid than *M. ochracea* and *M. borda.*

M. liturata Menke 1843. W.A. (S.W. Aust. ? type). With angulated longitudinal lines broken into spots. Specimens examined from S.W. Aust. are beach worn and without colour.

M. laevigata Brazier 1877. Qld., Darnley Island, Torres Strait, 10 fathoms, 20 fathoms, 30 fathoms (type), Raine Island, Cape York, 155 fathoms (type *M. valida*). New Guinea, 7 fathoms. W.A., beach. N.W. Aust. Recalling *M. geminata,* but shorter spired. Synonyms are *M. valida* Watson 1886, and *M. baudinensis* Smith 1899, Baudin Is.

M. weedingi Cotton 1944. Backstairs Passage, 20 fathoms (type), 40 fathoms to 200 fathoms. The species lives down to 20 fathoms. Rare and dead in deeper water. The shell is larger and narrower than *M. geminata* and has plaits resembling somewhat those of *M. laevigata.*

M. crescere Laseron 1948. N.S.W., Point Halliday, 8 to 10 fathoms. Much broader and with a more pronounced shoulder than in *M. ochracea.*

M. laeviplicata Laseron 1948. N.S.W., Crookhaven, 30 to 35 fathoms (type). The present species has weaker columella plaits than has *M. ochracea.*

PLEISTOCENE AND SUB-RECENT SPECIES.

A number of species are found in Pleistocene deposits, and stranded beaches, some of them away from their present distribution. Among Woakwine Range material from certain sites are found large specimens of *M. muscaria,* now not living in South Australia. In the Tintinara bore at a depth of 100 feet were found numerous large specimens of *M. formicula* and *M. turbinata,* the former still living in Eastern Victoria and the latter in New South Wales on the east coast of Australia from New South Wales to Tasmania.

TERTIARY SPECIES.

Apparently the family *Marginellidae* is not represented in rocks older than the Eocene. The Australian Tertiaries have so many species in comparison to the Tertiaries in other parts of the world that this region may have been the chief centre of distribution. Tate 1878 described but did not figure eighteen Tertiary species, placing them in two groups, defined as follows:

1. Outer lip smooth; columella quadriplicate.
2. Outer lip dentate.

The last group was subdivided into three sections:

A. Columella quadriplicate.
B. Columella quinqueplicate.
C. Columella multiplicate.

The different species were then classified by their shape. As mentioned before, I have found the number of plaits an unsatisfactory feature in major classification and the same applies to the presence or absence of denticles in the outer lip, though both these features are good specific guides. In order to compare better the Australian Tertiary species with the Recent ones, they are here grouped under a similar plan to that used for classifying the Recent species. The type localities follow the name of each species. A few new species from bores in the Adelaide Plains (Adelaidean) are here described and most appear to be distinct from local, Victorian, or Tasmanian Miocene species. There are also a few new species described here from other fossil exposures.

MARGINELLA CLISIA sp. nov.

Pl. xvii.

Holotype. Vict., "Spring Creek" = Bird Rock, Vict., Janjukian. Reg. No. P 8782 S.A. Mus.

Shell small, rather thick, subtriangular, outer lip a little expanded, spire a little exsert with a large blunt protoconch, body whorl slightly constricted anteriorly, outer lip thickened, smooth, aperture wide, columella with four oblique plaits, the anterior pair very oblique. Height 4 mm., width 2 mm.

Remarks. *M. clisia* is a slightly larger species than *M. micula* and it has a more exsert blunt-topped spire.

MARGINELLA PHYSA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 69, Adelaide Plains, 320 feet, Adelaidean. P. 8792 S.A. Mus.

Shell rather globose and thick with a short blunt spire, wide aperture and rather convex outer lip; columella a little concave, with four narrow oblique plaits occupying the anterior half; edge of the outer lip narrowly thickened and smooth. Height 4 mm., diameter 3 mm.

Remarks. Somewhat like *M. hordeacea* but more globose.

MARGINELLA REGULA sp. nov.

Pl. xviii.

Holotype. Aldinga, Lower Beds. P. 8785 S.A. Mus.

Shell rather large and thick, spire fairly long with angulated whorls; aperture short; columella with five weak plaits, the posterior one almost obsolete; outer lip regularly denticulate. Height 7·5 mm., diameter 3·8 mm.

Remarks. Differs from *M. muscaroides* in being thickened and having a strongly denticulate outer lip.

MARGINELLA META sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 21, Adelaide Plains, 400 feet, Adelaidean. Reg. No. P. 8795 S.A. Mus.

Shell fusiform with a long spire; protoconch blunt at the top; columella concave with four narrow but strong plaits; outer lip thickened with four or five strong denticles on the inner edge; body whorl about four times as high as the spire. Height 4 mm., diameter 2 mm.

Remarks. This species resembles *M. altispira*, but it has a shorter spire and more strongly denticulate outer lip, but it has not the single large posterior denticle on the outer lip.

MARGINELLA DOMA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 28, Adelaide Plains, 360 feet, Adelaidean. P. 8793 S.A. Mus.

Shell ovate, thick, polished, spire not visible above the body whorl; columella gently convex with five moderately developed plaits on the anterior half; outer lip thickened on the margin, which is almost entirely covered with numerous fine denticles. Height 5·2 mm., diameter 3·9 mm.

Remarks. The species is larger than *M. moana* and the outer lip reaches up to, but not above, the top of the spire. The two anterior plaits are much stronger than the others.

MARGINELLA CLIMA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 21, Adelaide Plains, 400 feet, Adelaidean. P. 8797 S.A. Mus.

Shell rather globose, smooth and polished; shoulder of body whorl rounded; columella concave anteriorly with four oblique plaits occupying the anterior

half; outer lip well thickened, smooth and wide medially, forming a moderately wide aperture; spire a little exsert. Height 5·2 mm., diameter 3·7 mm.

Remarks. Similar to *M. micula* but larger and having a less gradate spire.

MARGINELLA METULA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 21, Adelaide Plains, 400 feet, Adelaidean. P. 8782 S.A. Mus.

Shell elongately ovate, rather narrow, spire depressed, only one whorl visible; columella gently convex with twelve weak plaits, the anterior two a little longer and firmer; aperture long and narrow, outer lip with numerous, fine, weak denticles. Height 5·2 mm., diameter 3·2 mm.

Remarks. Nearest to *M. septemplicata* but narrower, and it has more plaits on the columella. The holotype is of medium size for the species, some being quite 6 mm. in height.

MARGINELLA ARENA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 21, Adelaide Plains, 400 feet, Adelaidean. Reg. No. P. 8794 S.A. Mus.

Shell ovate, smooth, spire very slightly depressed below the top of the shell; columella convex, with six plaits; outer lip narrowly thickened at the edge and smooth; aperture, crescent-shaped. Height 3 mm., diameter 2 mm.

Remarks. Larger than *M. globiformis,* it has only three well developed columella plaits anteriorly, and three less developed plaits on the posterior half of the columella.

MARGINELLA TALLA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Bore 21, Adelaide Plains, 400 feet, Adelaidean. Reg. No. P. 8796 S.A. Mus.

Shell narrowly ovate, spire a little exsert; body whorl narrow, rounded at the shoulder; columella straight, with four folds, the anterior three fairly strong and oblique, the posterior one weaker and slightly oblique; outer lip narrowly thickened and smooth at the edge, slightly sinuous, posteriorly arched, meeting the body whorl at the top. Height 4 mm., diameter 3 mm.

Remarks. Almost like a miniature *M. inermis* but with a taller spire, outer lip with smooth, thickened edge.

MARGINELLA PERA sp. nov.

Pl. xvii.

Holotype. Vict., Muddy Creek, Lower Beds. Reg. No. P. 8786 S.A. Mus.

Shell small, ovate, spire small and short and smooth, columella with four plaits, outer lip moderately thickened with about sixteen regular, minute denticles, body whorl rounded at the shoulder. Height 3·3 mm., width 2 mm.

Remarks. The type specimen described here as *M. pera* sp. nov. was in the W. L. May Collection identified as *M. kitsoni*. The present species differs from *M. kitsoni* in being narrower and having a comparatively smaller body whorl, while the columella plaits are differently situated.

MARGINELLA PALLA sp. nov.

Pl. xviii.

Holotype. Tate Mus., University of Adelaide, Adelaide Bore, Janjukian.

Shell small, pyriform, spire short, obtuse; body whorl angulate and weakly axially plicate at the shoulder; penultimate whorl also axially plicate at the shoulder; columella plaits four; outer lip angulate posteriorly, the inner edge numerously denticulate. Height 3·2 mm., diameter 2·4 mm.

Remarks. The holotype and other specimens were on the same tablet as the holotype and paratypes of *M. aldingae*. *M. palla* is smaller and has a denticulate, not smooth, outer lip.

MARGINELLA MALA sp. nov.

Pl. xviii.

Holotype. Aldinga, Lower Beds. Reg. No. P. 4016 S.A. Mus.

Shell volutiform, spire rather short; body whorl angled at the shoulder, smooth, solid, polished; columella a little convex above, slightly concave below where there are five plaits, the anterior four having a duplex formation, the posterior plait weaker and single; outer lip slightly convex, well thickened at the margin and denticulate on the inner edge. Height 9 mm., diameter 6 mm.

Remarks. A rather distinct species. Somewhat like *M. muscaroides* but larger and with different aperture features.

MARGINELLA CHARMA sp. nov.

Pl. xviii.

Holotype. S.A. Dept. of Mines., Bore 28, Adelaide Plains, 360 feet, Adelaidean. Reg. No. P. 8783 S.A. Mus.

Shell rather thick, somewhat *"Cassis"*-shaped, body whorl smooth, spire short; columella concave anteriorly with four strong, narrow, well-spaced plaits grouped at the anterior third; the anterior plait strong and continuing into the thickened outer lip which is obsoletely irregularly denticulate within. Height 4 mm., width 3 mm.

Remarks. *M. charma* recalls *M. cassida*, but in the latter species the spire is longer, the shell narrower and the outer lip is not denticulate.

MARGINELLA CASSIDA sp. nov.

Pl. xviii.

Holotype. S.A. Dept. of Mines, Bore 21, Adelaide Plains, 400 feet, Adelaidean. Reg. No. P. 8789 S.A. Mus.

Shell rather thick ovate, spire moderate in length, body whorl rounded at the shoulder, not angulate, smooth and polished; columella almost straight; with four narrow though moderately well-developed plaits, the posterior one almost horizontal; outer lip narrowly thickened, not denticulate. Height 5 mm., diameter 3 mm.

Remarks. The species is somewhat like *M. strombiformis* but it is a wider shell with smooth outer lip.

MARGINELLA SAGMA sp. nov.

Pl. xviii.

Holotype. S.A. Dept. of Mines, Bore 65, Adelaide Plains, 395 feet, Adelaidean. Reg. No. P. 8798 S.A. Mus.

Shell rather thick, smooth, polished, pyriform—ovate; spire slightly exsert, of three small whorls, sharp at the apex; columella a little concave anteriorly, with three strong oblique plaits and a fourth plait, a little away from the others, less strongly formed and horizontal; outer lip thickened at the edge where it is smooth; aperture of medium opening and slightly sigmoid. Height 4·5 mm., diameter 3 mm.

Remarks. *M. sagma* is probably nearer to *M. cassida* than to any other species. It differs in being wider, having a more shouldered body whorl, and in the disposition of the plaits.

MARGINELLA CRISTA sp. nov.

Pl. xviii.

Holotype. S.A. Mines Dept., Weymouth's Bore, Adelaide Plains, 450 feet, Adelaidean. Reg. No. P. 8791 S.A. Mus.

Shell small, elongate, fusiform, smooth; with a long spire and blunt protoconch; body whorl angled just below the suture, narrow and slightly convex anteriorly where there is a slight thickening; columella a little concave, with four plaits increasing somewhat in strength posteriorly; outer lip narrowly thickened at the margin and finely denticulate within; a larger denticle terminates the series of denticles on the lip posteriorly. Height 4·8 mm., diameter 2 mm.

Remarks. The species described here is smaller than *M. wentworthi* and has a long spire with a notably blunt protoconch. *M. altispira* also recalls this new species in the long spire and large denticle at the posterior end of the outer lip.

SUMMARY OF TERTIARY SPECIES.

GROUP A.

M. kalimnae Chapman and Crespin 1933. No. 1 Bore, Parish of Bumberrah, East Gippsland, Vict., 80 to 90 feet, Kalimnan, Lower Pliocene. Resembles *M. muscaroides* but is much larger and the thickened margin of the outer lip is not produced into a flange-like extension as in *M. muscaroides.*

M. muscaroides Tate 1878. Muddy Creek, Lower Beds. Shell volutiform, outer lip smooth, columella with four plaits. The species is like a small *M. muscaria* but has a less calloused outer lip, spreading over the penultimate whorl and base of the shell giving a flattened appearance and a varicose margin in the left side.

M. wentworthi Tenison Woods 1877. Table Cape. Ovate, lanceolate, outer lip dentate, columella with four plaits. Differs from *M. muscaria* in shape and apertural features.

M. woodsi Tate 1878. Muddy Creek, Lower Beds. Ovate, solid, spire short obtuse, outer lip denticulate, columella with five plaits. Somewhat intermediate between *M. wentworthi* and *M. muscaroides,* but distinguished by its shorter spire and five plaited columella.

M. atkinsoni May 1922. Table Cape. Broadly fusiform, smooth, whorls four, much rounded, spire exsert about one-third the length of the shell, broadly shouldered but tapering narrowly anteriorly, columella with four strong plaits, outer lip curved, very heavily thickened, denticulate with about twelve irregular denticles. Broader than *M. wentworthi,* whorls more rounded, outer lip more heavily variced. There is a variant with a more squat form and massive lip, from Table Cape, recalling *M. inermis.*

M. corpulenta May 1922. Table Cape. Broadly pyriform, spire elevated, protoconch mamillated, whorls four, well rounded, broadly shouldered, columella

convex above, excavate below, with four thin plaits, outer lip thick, rounded, weakly denticulate within. Related to *M. atkinsoni* but broader, and has weakly developed denticles on the outer lip.

M. subquinquidens May 1922. Table Cape. Broadly fusiform with a prominent blunt-topped spire, whorls four, rounded not shouldered, columella with five strong plaits, fourth plait, next to the posterior one, less well developed, sometimes absent, outer lip thickened, smooth within. This fossil is like a miniature of the Recent *M. muscaria.*

M. regula sp. nov. Aldinga, Lower Beds. Related to *M. muscaroides* but larger and having a strongly denticulate outer lip.

M. mala sp. nov. Aldinga, Lower Beds. Somewhat like *M. muscaroides* in shape but much bigger.

GROUP B.

M. octoplicata Tenison Woods 1877. Table Cape. Pyriform, spire scarcely visible, columella with eight plaits, anterior valid, scarcely oblique, the posterior four weak; outer lip thickened, very regularly denticulate with twelve raised linear teeth. The body whorl has distinct striated growth lines vaguely recalling *M. turbinata.*

M. aldingae Tate 1878. Lower Beds. Fusiformly ovate, body whorl axially plicate, outer lip smooth, columella with four plaits. Related to the Recent *M. turbinata* and *M. pattisoni.*

M. cassidiformis Tate 1878. Muddy Creek, Lower Beds. Rather ventricose "*Cassis*"-shaped with plications on the shoulder of the body whorl, outer lip smooth, columella with four plaits. Probably related to *M. aldingae* but differing markedly in shape and apertural features. It is also a little like *M. pattisoni.*

M. strombiformis Tenison Woods 1877. Table Cape. Ovate, narrowed anteriorly, spire short obtuse, whorls four, outer lip dentate, columella with four plaits. Distinguished by the conspicuously thickened outer lip which is produced posteriorly.

M. praeformicula Chapman and Gabriel 1914. Mallee Bore, Kalimnan. Voluti-form, solid, spire medium height, exserted. Most closely allied to *M. formicula,* but there are fewer plications on the shoulder of the body whorl.

M. charma sp. nov. Adelaidean. This species has a shorter spire than *M. cassida* and the columella is concave anteriorly.

M. cassida sp. nov. Adelaidean. Related to *M. strombiformis* but has a shorter spire and smooth outer lip.

M. palla sp. nov. Adelaide Bore, Janjukian. This species has the shape of *M. aldingae* but it is a little smaller and has a denticulate outer lip.

GROUP C.

M. altispira May 1922. Table Cape. Broadly fusiform with a tall blunt-topped spire, columella concave, with four strong plaits, outer lip much thickened, having a strong tubercle within at the upper third. It resembles the recent *M. allporti,* but the fossil is smaller and has a more exsert spire.

M. meta sp. nov. Adelaidean. The spire is shorter in *M. meta* than in *M. altispira* from Table Cape.

GROUP D.

M. hordeacea Tate 1878. Aldinga, Upper Beds. Broadly ovate, spire short, obtuse, outer lip very thick, strongly channelled above, inner edge smooth, with four strong columella plaits. Apparently related to *M. connectans* but more ovate and larger.

M. physa sp. nov. Adelaidean 320′ somewhat like *M. hordeacea* but distinctly more globose.

M. rotunda May 1922. Table Cape. Small, roundly pyriform, spire scarcely exserted, aperture as high as the shell, columella with three plaits, and two or three much smaller plaits or denticles above, outer lip rounded, strongly thickened, smooth within. The species was compared by May with *M. octoplicata* but it is probably more closely related to the recent *M. lubrica* Petterd. *M. octoplicata* has twelve denticulations on the outer lip.

M. kitsoni Chapman 1922. Torquay, Vict. Shell small, subovate, with rounded and gently graded shoulder; spire short, of three whorls, body whorl faintly marked with growth striae, columella with four plaits, outer lip rather thin, obsoletely denticulate. The species is rather like *M. shorehami* which has seven and not four columella plaits.

M. pera sp. nov. Muddy Creek, Lower Beds. Narrower and with a smaller body whorl than *M. kitsoni.*

GROUP E.

M. septemplicata Tate 1878. Muddy Creek, Lower Beds. Stoutly ovate, spire immersed, outer lip denticulated within, columella with seven strong plaits. The species is rather like those of the West African genus *Persicula.* The nearest Recent species appears to be *M. cymbalum.*

M. globiformis Chapman and Crespin 1928. Mitchell River, Miocene. Roundly ovate or subpyriform, spire immersed, outer lip thin, rounded and smooth, columella with five plaits. It recalls *M. multidentata* but the Recent species has a denticulated outer lip and nine columella plaits.

M. moana Ludbrook 1941. Abattoirs Bore, Adelaidean. Thick, pyriform, spire immersed, apical portion depressed aperture long and narrow, outer lip faintly denticulated within, columella with five plaits. A pear-shaped species close to *M. globiformis*. The holotype specimen figured here has five plaits and not four as originally described by the author of the species. The fifth posterior plait is less developed than the other four.

GROUP G.

M. micula Tate 1878. Muddy Creek, Lower Beds. Smooth, conically ovate, spire very small and obtuse, body whorl gibbous over the suture and constricted, attenuate anteriorly, outer lip minutely denticulated, aperture wide, curved, columella with four plaits. Somewhat like the Recent *M. weedingi* in shape and general features.

M. inermis Tate 1878. Muddy Creek, Lower Beds. Pyriform, attenuated anteriorly, spire very short, aperture strongly arched posteriorly, outer lip slightly variced, edge thin and denticulated, columella with four plaits. This species is related to *M. micula* and the Recent *M. weedingi*. It is distinguished from other Tertiary species by the pyriform shape, though this pyriform or triangular shape is characteristic of Group G.

M. winteri Tate 1878. Muddy Creek, Lower Beds. Narrowly ovate, spire exserted, subacute, aperture triangular, moderately wide in front, outer lip flexuous, thinly but broadly thickened and somewhat inflected, denticulated with about thirty small obtuse denticles, columella with five plaits. I would regard this species as closely related to the Recent *M. laevigata* but is larger and has five plaits on the columella.

M. doma sp. nov. Adelaidean. The species recalls *M. moana* but it is larger and the outer lip in the present species rises to the level of the spire but not above.

M. arena sp. nov. Adelaidean. This is probably related to *M. globiformis* but it is larger and has only three fully developed columella plaits and one posterior miniature one, well inside the aperture. It is something like the Tasmanian deep water Recent species *M. erma*.

M. propinqua Tate 1878. Muddy Creek, Lower Beds. Shell thick, ovate cylindrical, transversely streaked with white, aperture triangular, with a broad milk-white varix strongly denticulated on the bevelled edge, columella five plaits. Related to *M. winteri* but has a shorter spire and more tumid body whorl.

M. crassidens Chapman and Crespin 1928. Gippsland Lakes, Kalimnan. Polished, incrassate, volutiform, spire of medium height, body whorl broad at the shoulder, tapering anteriorly, outer lip finely denticulate, channelled at the anterior end, columella with four plaits. Related to *M. micula* but the spire is higher and the apex sharper.

M. clima sp. nov. Adelaidean. Probably the Pliocene relative of the Miocene *M. micula* which is a smaller shell with a more gradate spire.

M. metula sp. nov. Adelaidean. The species is nearest to *M. septemplicata* but it is narrower and has more numerous plaits on the columella.

M. talla sp. nov. Adelaidean. Differs from *M. inermis* in being smaller and having a shorter spire and smooth thickened outer lip.

M. clisia sp. nov. Bird Rock, Vict. Slightly larger and with a more exsert blunt topped spire than *M. micula.*

SUMMARY.

This paper presents a complete revision of Australian Recent and Tertiary Marginellidae. Recent species number 119 and Tertiary 38, here arranged into seven groups. Sixteen new Tertiary species are added, some of them having been taken from bores in the Adelaide Plains. Four new Recent species are also added.

REFERENCES.

Tate, 1878. *Trans. Roy. Soc. S. Aust.*, 1, pp. 85 to 98.
Hedley, 1916. *Proc. Linn. Soc. N.S.W.*, 41, pt. 4, p. 709.
Tomlin, 1917. *Mal. Soc.*, 12, pp. 242 to 306.
May, 1921. *Check List Moll. Tas.*, pp. 69 to 70.
Cotton, 1944. *South Aust. Naturalist*, 22, No. 4, pp. 9 to 16.
Laseron, 1948. *Rec. Aust. Mus.*, 22, No. 1, pp. 35 to 48.

EXPLANATION OF PLATES.

Plate xvii.

Marginella muscaroides Tate (× 4·7).
Marginella wentworthi Tenison Woods (× 5·8).
Marginella micula Tate (× 12).
Marginella inermis Tate (× 2·66).
Marginella corpulenta May (× 7·33).
Marginella aldingae Tate (× 11·13).
Marginella altispira May (× 6·66).
Marginella atkinsoni May (× 6·66).
Marginella strombiformis Tenison Woods (× 10).
Marginella septemplicata Tate (× 3·33).
Marginella pera sp. nov. (× 12·66).
Marginella winteri Tate (× 3·33).
Marginella moana Ludbrook (× 6·66).
Marginella propinqua Tate (× 3·33).
Marginella hordeacea Tate (× 6·66).
Marginella cassidiformis Tate (× 8).
Marginella subquinquidens May (× 6).
Marginella rotunda May (× 13·33).
Marginella woodsi Tate (× 3·33).
Marginella clisia sp. nov. (× 10).

Plate xviii.

Marginella globiformis Chapman and Crespin (× 14·73).
Marginella kalimnae Chapman and Crespin (× 2·57).
Marginella crassidens Chapman and Crespin (× 3·67).
Marginella meta sp. nov. (× 8·33).
Marginella octoplicata Tenison Woods (× 14·73).
Marginella praeformicula Chapman and Gabriel (× 3·93).
Marginella physa sp. nov. (× 8·33).
Marginella regula sp. nov. (× 4·47).
Marginella clima sp. nov. (× 6·67).
Marginella palla sp. nov. (× 10·21).
Marginella cassida sp. nov. (× 6·4).
Marginella doma sp. nov. (× 6·7).
Marginella arena sp. nov. (× 11·13).
Marginella charma sp. nov. (× 7·9).
Marginella metula sp. nov. (× 6·4).
Marginella sagma sp. nov. (× 7·33).
Marginella talla sp. nov. (× 6·33).
Marginella kitsoni Chapman (× 12·47).
Marginella mala Tenison Woods (× 3·87).
Marginella crista sp. nov. (× 7·4).

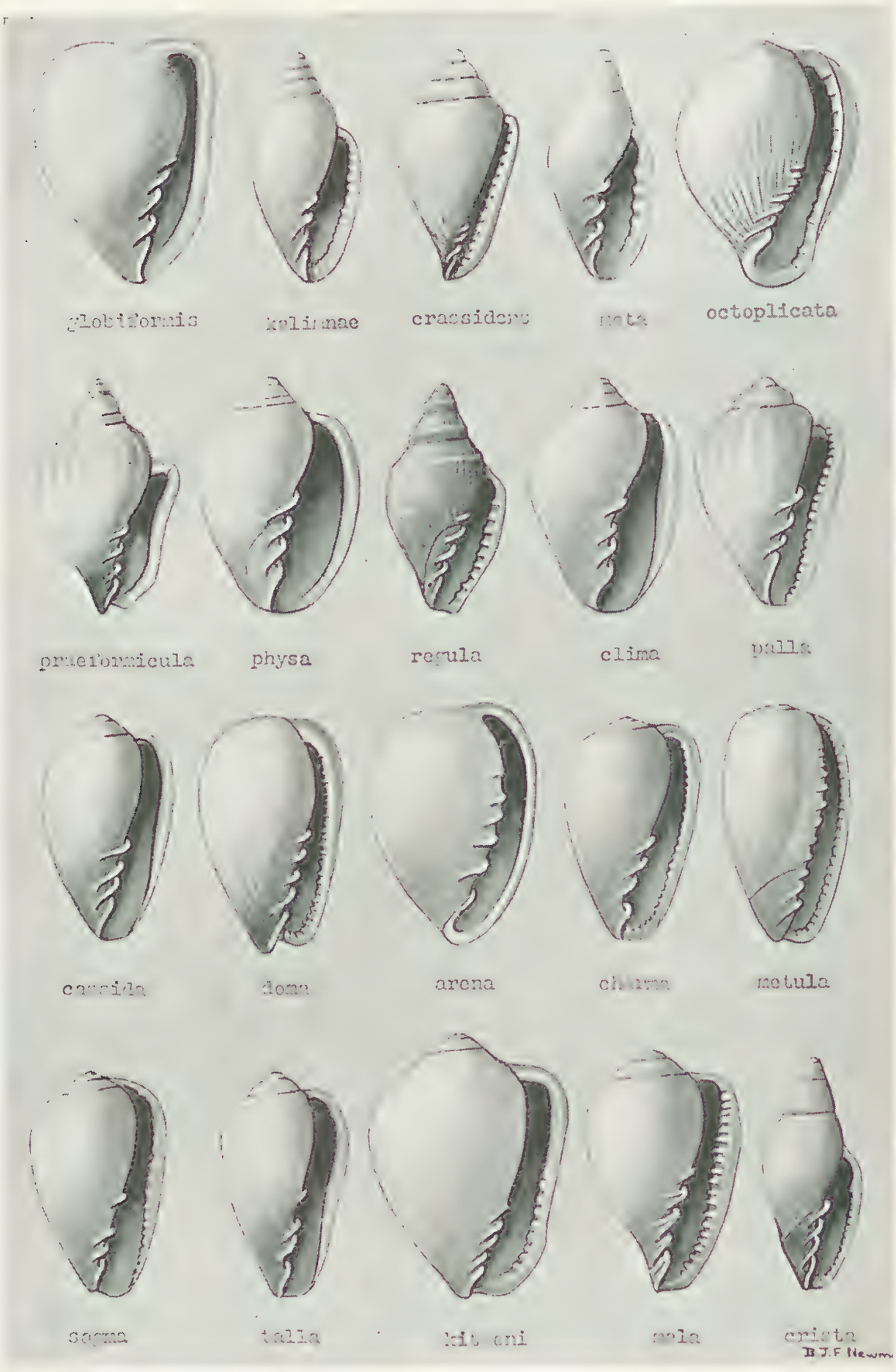
Plate xix.

Marginella muscaria Lamarck. Tas., E. Coast (× 1·9).
Marginella johnstoni Petterd. S.A., Kangaroo Island (× 3·8).
Marginella tasmanica Tenison Woods. Tas., Long Bay (× 3·4).
Marginella tridentata Tate. S.A., Aldinga (× 4·6).
Marginella mixta Petterd. Tas., E. Coast (× 4·5).
Marginella pygmaeoides Singleton. S.A., Kangaroo Island (× 3·6).
Marginella schoutanica May. S.A., Beachport, 40 fathoms (× 8·3).
Marginella consobrina May. Tas., Cap Pillar, 100 fathoms (× 6·7).
Marginella vercoi May. Tas., Cape Pillar, 100 fathoms (× 4·2).
Marginella sica sp. nov. W.A., Eucla, 200 fathoms (× 6·7).
Marginella inconspicua Sowerby. N.S.W., Ballina (× 4·7).
Marginella victoriae Gatliff and Gabriel. Vict., Western Port (× 8·2).
Marginella translucida Sowerby. N.S.W.(× 3·5).
Marginella alta Watson. Q., Raine Island, 155 fathoms (× 7·9).
Marginella carinata Smith. N.S.W., Sydney, 410 fathoms (× 6·5). (× 6·5).
Marginella fusiformis Hinds. Straits of Malacca (× 3·3).
Marginella formicula Lamarck. Tas., Maria Island (× 3).
Marginella georgiana May. Tas., Southport (× 3·6).
Marginella praetermissa May. Tas., E. Coast (× 2).
Marginella leia Cotton. S.A., Beachport, 150 fathoms (× 3·8).

Plate xx.

Marginella newmanae sp. nov. W.A., Esperance (× 3·7).
Marginella kemblensis Hedley. N.S.W., Port Kembla, 63–75 fathoms (× 4·2).
Marginella patria sp. nov. W.A., Hopetoun, 35 fathoms (× 8).
Marginella walkeri Smith. N.W.A., Baudin Island (× 2·7).
Marginella tomliniana May. Tas., Thouin Bay, 40 fathoms (× 16·7).
Marginella multidentata May. Tas., d'Entrecasteaux Channel, 10 fathoms (× 16·7).
Marginella baca sp. nov. Tas., Cape Pillar, 100 fathoms (× ·73).
Marginella columnaria Hedley and May. Tas., Cape Pillar, 100 fathoms (× 4·7).
Marginella olivella Reeve. N.S.W., Port Jackson (× 4).
Marginella petterdi Beddome. Tas., Kelso Bay, Tamar River, 17 fathoms (× 6·8).
Marginella laevigata Brazier. Q., Darnley Is., Torres Strait, 10 fathoms (× 5·2).
Marginella mustellina Angas. N.S.W., Port Jackson (× 4·5).
Marginella mayi Tate. Schouten Is., 40 fathoms (× 3).
Marginella maugeana Hedley. Tas., Cape Pillar, 100 fathoms (× 2·7).
Marginella geminata Hedley. N.S.W., Cape Byron (× 4·7).
Marginella subbulbosa Tate. S.A., Port Lincoln (× 8).
Marginella cylichnella May. Tas., Cape Pillar, 100 fathoms (× 16).
Marginella erma sp. nov. Tas., Cape Pillar, 100 fathoms (× 16·7).
Marginella columnaria Hedley and May. Tas., Cape Pillar, 100 fathoms (× 4·5).
Marginella weedingi sp. nov. S.A., Backstairs Passage, 20 fathoms (× 4·7).

muscaroides
wentworthi
micula
inermis
corpulenta
altispira
atkinsoni
strombiformis
septemplicata
propinqua
hordeacea
cassidiformis
subquinquidens
rotunda
woodsi
clisia
B.J.F.Neumo


globiformis
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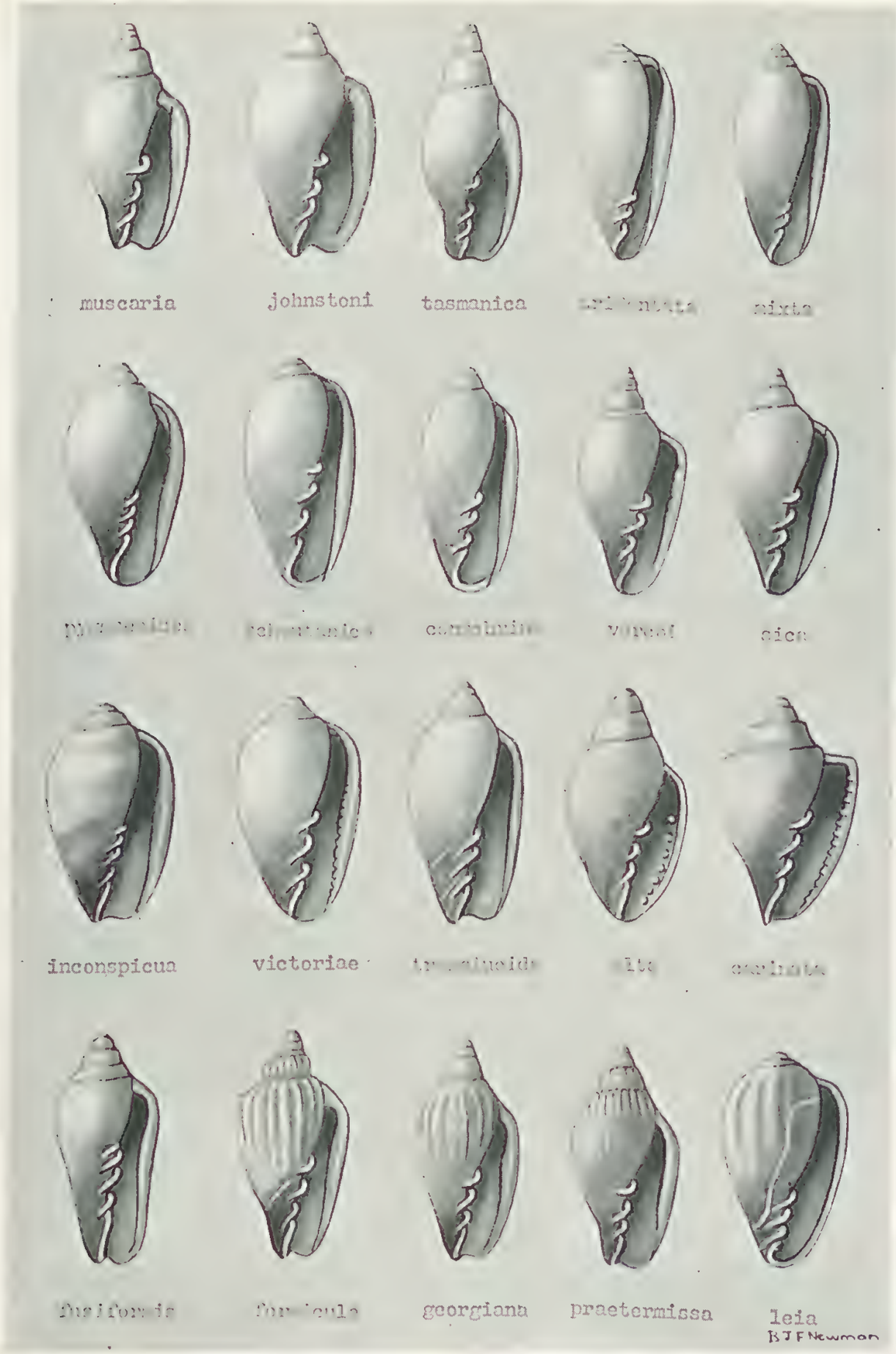
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johnstoni
tasmanica
mixta
inconspicua
victoriae
leia
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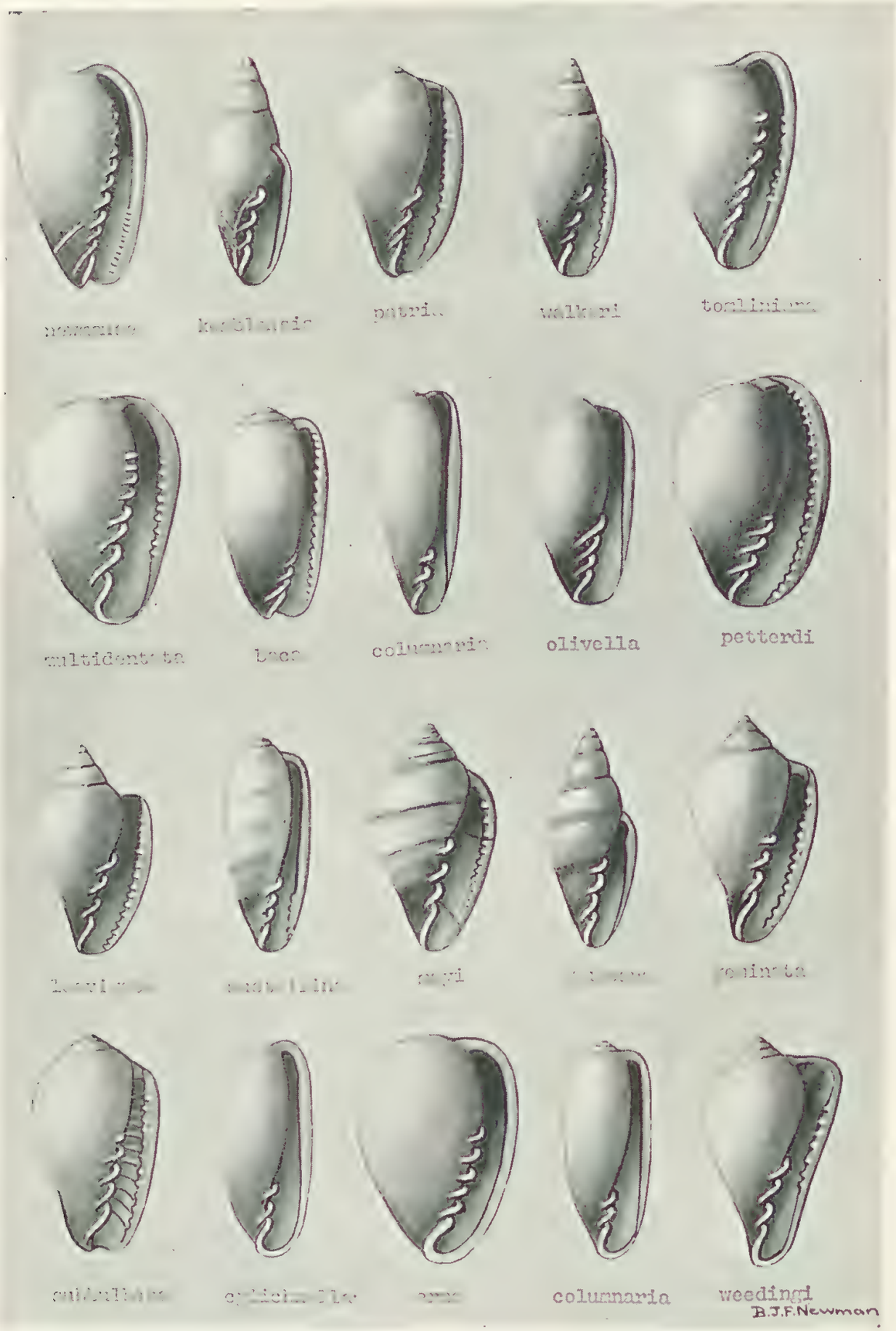
olivella
petterdi
columnaria
weedingi
B.J.F.Newman

AUSTRALIAN CUMACEA. No. 16[1]

The FAMILY NANNASTACIDAE[2]

By HERBERT M. HALE, Director South Australian Museum.

Fig. 1–12.

The Nannastacids dealt with in this paper are mostly from Western Australia, where the material was secured by Dr. A. G. Nicholls and Mr. G. P. Whitley. As a result of these collections, all made by means of submarine light traps[3], fourteen species of the family are added to the Western Australian list, which now stands as follows:

Genus Nannastacus Bate.

nasutus Zimmer.
nasutus var. *camelus* Zimmer.
inconstans Hale.
asper Hale.
inflatus Hale.
subinflatus Hale.
nichollsi sp. nov.
vietus sp. nov.

Genus Schizotrema Calman.

aculeata Hale.
leopardina sp. nov.
resima sp. nov.

Genus Cumella Sars.

gibba Zimmer.
cyclaspoides Zimmer.
hispida Calman.
michaelseni Zimmer.
similis Fage.
cana Hale.

Genus Campylaspis Sars.

unisulcata Hale.
cf. similis Hale.
minor Hale.

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1 For No. 15 see *Rec. S. Aust. Mus.*, IX, 1949, pp. 107–125, fig. 1–9.
2 See also *Rec. S. Aust. Mus.*, VIII, 1945, pp. 145–218, fig. 1–49.
3 Sheard, *Rec. S. Aust. Mus.*, VII, 1941, pp. 11–14, fig. 1.

Also described are a new species of *Cumellopsis,* the first member of the genus to be noted in the Southern Hemisphere, and the hitherto unknown female of *Campylaspis echinata* Hale.

Genus NANNASTACUS Bate.

Seven species, two of which are new, are available from Western Australia.

NANNASTACUS NASUTUS Zimmer.

Nannastacus nasutus Zimmer, 1914, p. 184, fig. 11–12; Hale, 1945, p. 148, fig. 1.

Specimens have been taken by G. P. Whitley at the type locality, Shark Bay (lat. 25.30 S.), and several places to the north of this, on the Western Australian coast. As previously noted (Hale, *ut supra,* p. 150) Zimmer's var. *camelus* appears to be a southern form of the species.

NANNASTACUS INCONSTANS Hale.

Nannastacus inconstans Hale, 1914, p. 150, fig. 2–3.

More than 350 males were taken by A. G. Nicholls at Garden Island, Western Australia; both forms occur here, the granulate or cristate one, and that with inflated branchial regions.

Males were taken also at Shark Bay by G. P. Whitley.

NANNASTACUS ASPER Hale.

Nannastacus asper Hale, 1914, p. 154, fig. 6–7.

Males collected at Esperance Bay, Western Australia, by A. G. Nicholls extend the known distribution of the species, formerly recorded from Tasmania and South Australia.

NANNASTACUS INFLATUS Hale.

Nannastacus inflatus Hale, 1945, p. 159, fig. 10–11.

Many specimens, most of which are males, were collected by A. G. Nicholls and G. P. Whitley from the following localities: Esperance Bay, Rottnest Island, Garden Island, Shark Bay, Geraldton, Houtman Abrolhos, Mary Anne Group (lat. 22.00 S. to 32.50 S.).

NANNASTACUS SUBINFLATUS Hale.

Nannastacus subinflatus Hale, 1945, p. 162, fig. 12–13.

Material of this species was collected from all the Western Australian localities given for *inflatus* and was taken also on the eastern side of North-West Cape.

NANNASTACUS NICHOLLSI sp. nov.

Adult female. Carapace one-third of total length of animal and almost twice as long as pedigerous somites together; it is slightly depressed and its depth is more than two-thirds its length; at the rear is a rather prominent median elevation, below and behind the eye is a tumidity, seated in a shallow depression, while below the posterior elevation is a smaller hollow; between the two depressions is a slight tumidity. Pseudorostrum one-seventh of length of carapace, directed very obliquely upwards; lobes meeting for whole length, and finely serrate in front. Antero-lateral margin shallowly concave; antero-lateral angle produced as a tooth, above which are three smaller teeth; inferior margin serrate anteriorly.

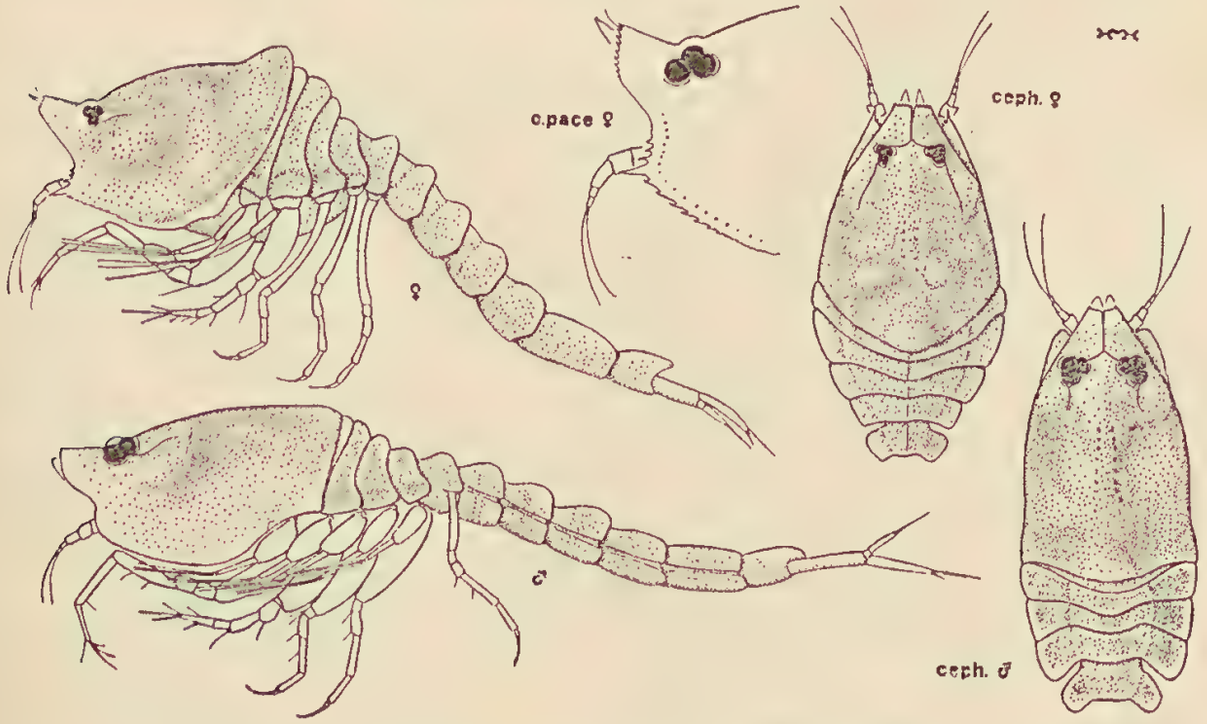


Fig. 1. *Nannastacus nichollsi*, types female and male; lateral views and (ceph.) cephalothorax from above (× 32); c. pace, anterior part of carapace (× 45).

All pedigerous somites exposed, each with a fine median longitudinal dorsal carina and with pleural parts swollen but not greatly expanded fore and aft.

Pleon equal in length to cephalothorax; first somite (unlike remaining abdominal somites) with a fine median carina on back, which, like that of last pedigerous somite, is raised; second to fourth somites successively less tumid dorsally; fifth half as long again as either fourth or telsonic somites; the last-named is widest at the rear, with posterior margin rounded, and is barely longer than wide.

Second and third peduncular joints of first antenna subequal in length, together equal in length to first; flagellum with two joints of equal length, together as long as last segment of peduncle.

Third maxilliped without exopod.

First peraeopod with propodus equal in length to carpus and twice as long as dactylus; ischium with an inner apical tooth. Second peraeopod with ischium distinct; basis a little shorter than rest of limb, the joints of which are as in *sheardi* but longer terminal dactylar spine is longer than propodus and dactylus together.

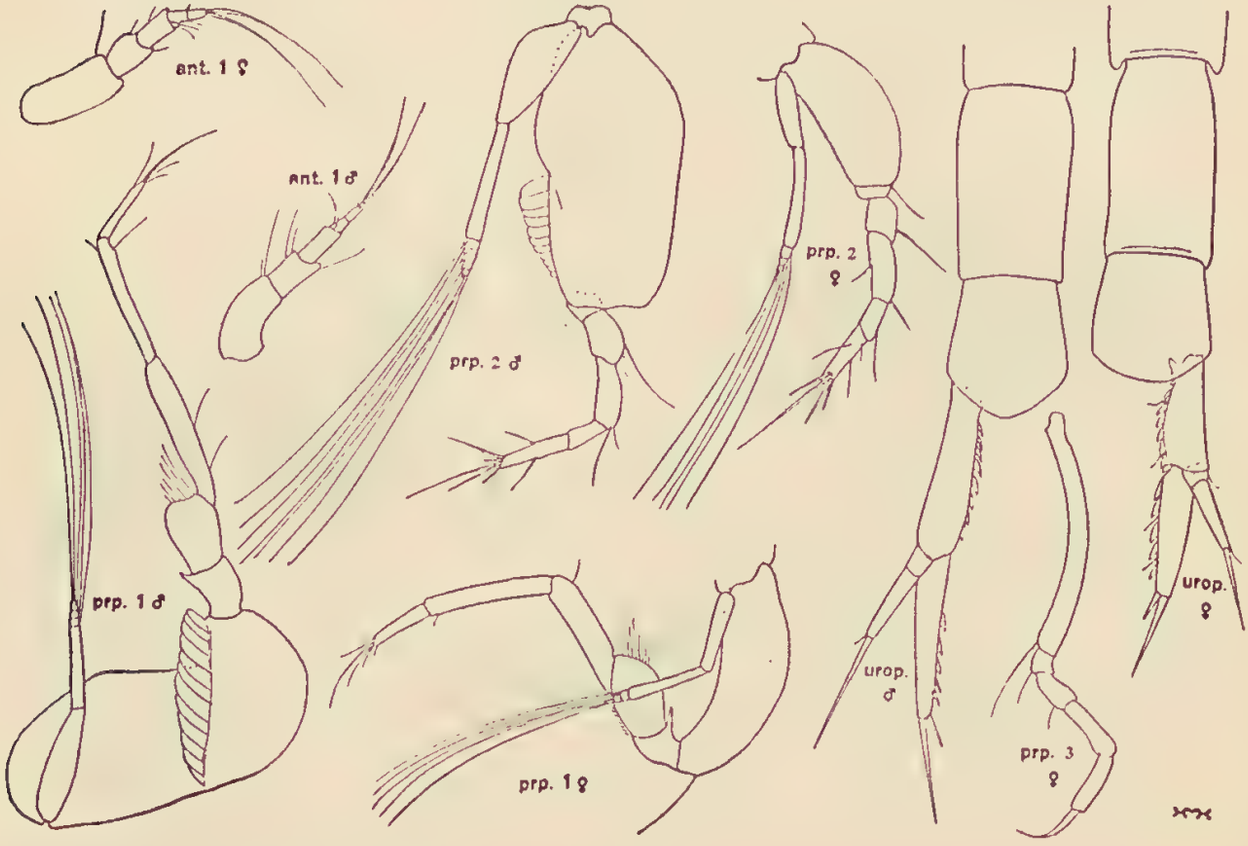


Fig. 2. *Nannastacus nichollsi*, type female and paratype male; ant. 1, first antenna; prp. 1–3, first, second and third peraeopods; urop., uropod with fifth pleon and telsonic somites (all × 112).

Peduncle of uropod shorter than telsonic somite and shorter than endopod without terminal spine; inner edge with hyaline serrations; exopod two-thirds as long as endopod, and little longer than terminal spine, which reaches well beyond distal end of endopod; endopod equal in length to telsonic somite, with serrate inner margin, and with two very unequal stout terminal spines, the longer of which is two-thirds as long as the ramus.

Colour white, without pigmentation. Length 1·4 mm.

Adult male. Integument, like that of female, without granulation.

Carapace more than one-third of total length of animal, slightly depressed, and nearly twice as long as deep; the sculpture, as described for the female, is present but is only faintly defined. Pseudorostrum one-sixth of length of carapace, not upturned. Antennal angle rounded and without spines; inferior margin finely crenulate anteriorly. Antero-lateral margin shallowly concave.

Pedigerous somites together almost half as long as carapace, first with pleural parts concealed; second to fourth with pleural portions slightly expanded.

Pleon a little shorter than cephalothorax, with first three somites, like last pedigerous somite, slightly tumid dorsally; fifth one-third longer than either fourth or telsonic somites; the latter is distinctly longer than wide.

First peraeopod with carpus a little longer than propodus and more than twice as long as dactylus; ischium with inner distal tooth as in female.

Basis of second peraeopod larger than in female; remaining joints of same proportions but longest dactylar spine relatively shorter.

Peduncle of uropod barely one-fourth as long again as telsonic somite, scarcely longer than endopod, and with inner margin serrate; exopod less than two-thirds as long as endopod and with its terminal spine longer than the ramus; endopod with two unequal distal spines, preceded by two short spines and a row of serrations on inner margin; longest terminal spine equal in length to exopod.

Colour: carapace brown, with a border of pale yellow along inferior and anterior margins; second to fifth pedigerous somites brown, margined all around with yellow; pleon somites yellow with indefinite transverse brown markings. Length 1·5 mm.

Loc. Western Australia: Garden Island, Careening Bay, 3 fathoms (A. G. Nicholls, submarine light, Nov. 1946). Types in South Australian Museum, Reg. No. C.3186 and 3135.

A single female and several males of this Nannastacid were taken. *N. nichollsi* resembles *sheardi* (Hale, 1945, p. 156, fig. 8–9) in some respects. It agrees in the relatively long pseudorostrum and in the proportions of the peraeopods, but differs as follows:

FEMALES.

Carapace not granulate but with a well-marked tumidity situated below eye lobe and seated in a shallow depression; a similar but smaller depression below the median elevation at rear of carapace. Third maxilliped without exopod. Uropod with peduncle shorter than endopod and with exopod two-thirds as long as endopod (not including terminal spines in length of either ramus) . . . . . *nichollsi* sp. nov.

Carapace granulate and not sculptured as above. Third maxilliped with exopod. Uropod with peduncle much longer than endopod and with exopod three-fourths as long as endopod .. .. *sheardi* Hale

MALES.

Carapace not granulate but with slight depressions and tumidities. Uropod with peduncle barely one-fourth as long again as telsonic somite and with exopod less than two-thirds as long as endopod (not including terminal spines) .. ..

First joint of peduncle of first antenna equal in length to second and third segments together; third barely longer than second and one-third as long again as flagellum, the first joint of which is longer than second; accessory flagellum relatively large, single-jointed.

Third maxilliped with propodus curved, one-third as long again as carpus, which is slightly longer than merus; basis equal in length to rest of limb.

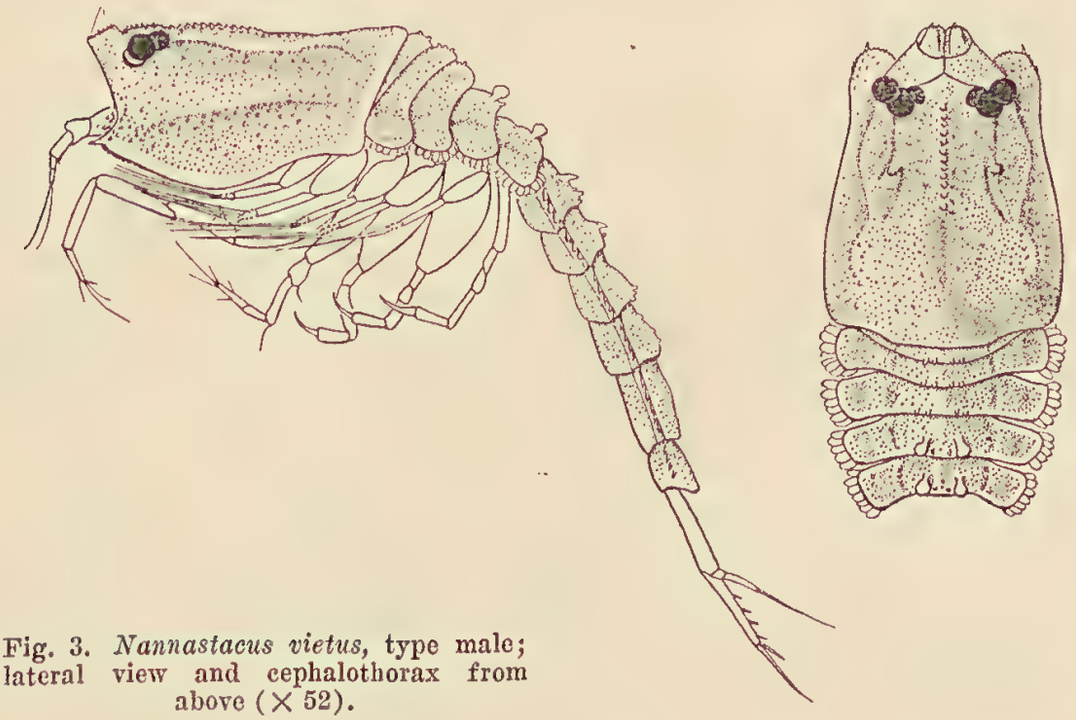


Fig. 3. *Nannastacus vietus*, type male; lateral view and cephalothorax from above (× 52).

Basis of first peraeopod three-fifths as long as rest of limb; ischium with a strong outer distal spine; propodus a little shorter than carpus and less than twice as long as dactylus, which is shorter than its stoutest apical seta.

Basis of second peraeopod distinctly longer than rest of limb; ischium indistinct; merus two-thirds as long as carpus, which is not much shorter than propodus and dactylus together; dactylus half as long again as propodus and with longest terminal spine as long as propodus and dactylus together.

Third and fourth peraeopods with basis a little shorter than rest of limb, the joints of which are short, stout, and subequal in length, the propodus a little longer than the others.

Fifth peraeopod with basis half as long as combined lengths of remaining joints; ischium and merus subequal in length, each a little shorter than propodus; carpus one-third as long again as propodus and little longer than dactylus.

Peduncle of uropod almost half as long again as telsonic somite, somewhat dilated at distal end, and furnished with some non-articulated spines, of which three on inner face in proximal half are conspicuous; endopod equal in length to peduncle, armed with four short spines on inner margin and with two unequal stout terminal spines, the longer finely serrate in distal half and not much shorter than the ramus, while the shorter spine is distinctly less than half as long as this and bears minute lateral setae in proximal half; exopod four-sevenths as long as endopod and with a long slender distal spine, twice as long as the ramus.

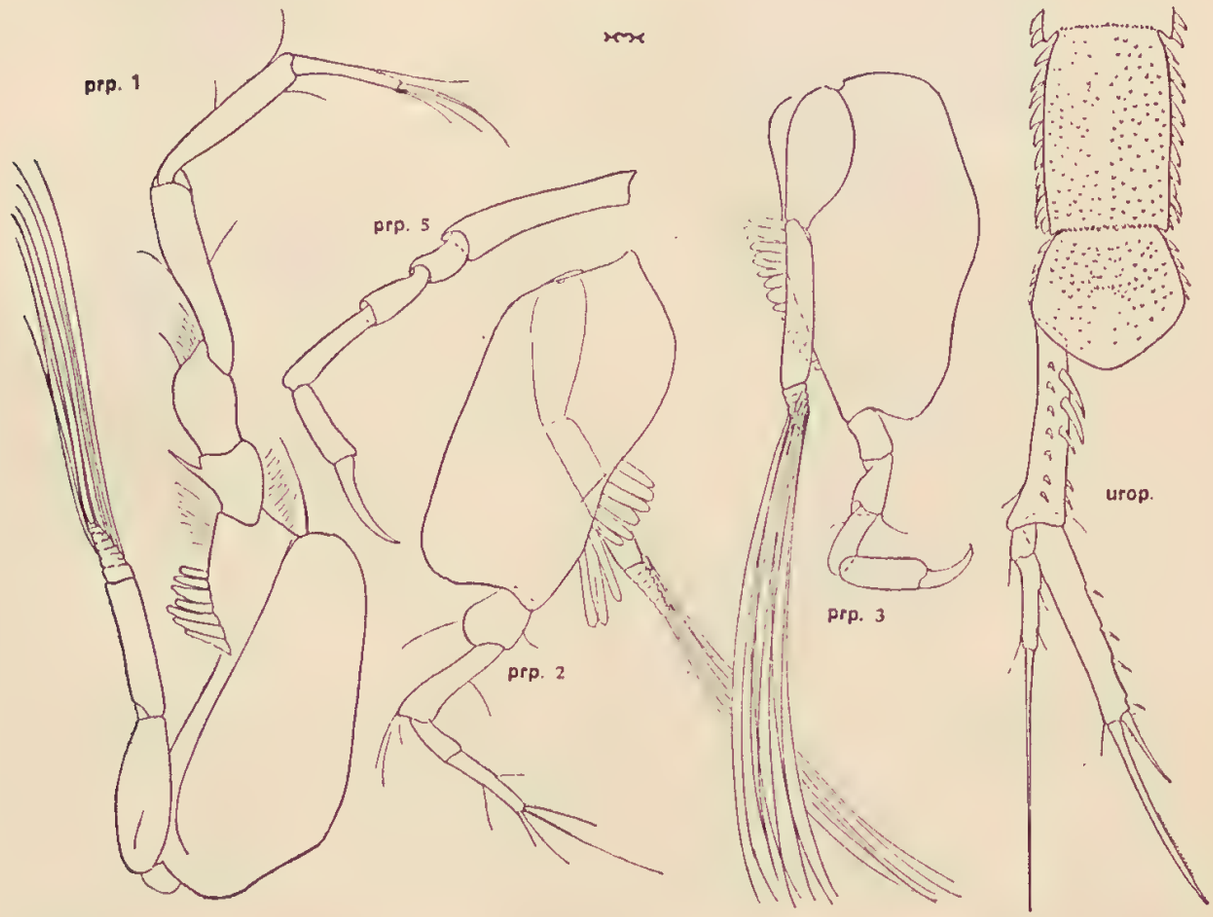


Fig. 4. *Nannastacus vietus*, type male; prp. 1–3 and 5, first, second, third and fifth peraeopods; urop., uropod with fifth pleon and telsonic somites (all × 120).

Colour: carapace dark grey with margins and ridges pale yellow. Pedigerous somites and pleon greyish. Appendages pale yellow. Length 1·7 mm.

Loc. Western Australia: Garden Island, Careening Bay, 3 fathoms (type loc., A. G. Nicholls, submarine light, Nov. 1946); Mary Anne Group, 3½ fathoms (G. P. Whitley, submarine light, Nov. 1945). Type in South Australian Museum, Reg. No. C.3137.

A male from the Mary Anne Group, on the north-western Australian coast, is 1·5 mm. in length and differs from the Garden Island males in having the ridges of the carapace, particularly the lateral one, not quite so pronounced.

N. vietus, like *nichollsi*, falls arbitrarily next to *sheardi* in the author's key to the males of the species of the genus (Hale 1945, p. 146); it differs, however, in several prominent features, notably the sculpture of the carapace, the shorter pseudorostrum, the short and stout fossorial peraeopods and the character of the uropod. It is related to *stephenseni* (Fage, 1945, p. 201, fig. xxiii, male only) but in the last-named the telsonic somite is of distinctive shape, the uropods have different armature, with the peduncle shorter and the exopod (without terminal spine) longer in relation to the endopod, etc.

Genus SCHIZOTREMA Calman.

With the two species described below as new, nine forms are now referable with certainty to this genus. *S. depressa* Calman has been taken in South Australia (Hale, 1937, p. 74) so that four of the species occur on Australian coasts.

KEY TO SPECIES OF *SCHIZOTREMA*.

1. Peduncle of uropod much longer than endopod .. .. *calmani* Stebbing
   Peduncle of uropod much shorter than endopod 2
2. Carapace broad and depressed. Peduncle of uropod longer than telsonic somite .. .. *depressa* Calman
   Carapace not or little depressed. Peduncle of uropod much shorter than telsonic somite 3
3. Exopod of uropod half, or almost half, as long as endopod (not including terminal spines in length of either ramus) 4
   Exopod of uropod much less than half as long as endopod 6
4. Each pleon somite with at least one pair of outstanding dorsal spines (in both sexes) .. .. *aculeata* Hale
   Pleon somites with at most inconspicuous spines 5
5. Surface of body with numerous small spines and tubercles; antero-lateral angle of carapace produced as a stout cylindrical process *bifrons* Calman
   Surface of body for the most part smooth; antero-lateral angle of carapace produced as a slender tooth .. .. *sordida* Calman
6. At least some of the pedigerous and pleon somites with conspicuous dorsal spines 7
   Dorsum of pedigerous and pleon somites with at most inconspicuous spinules 8
7. Carapace with back and sides spiny, and with antero-lateral angle broad, not at all downbent .. .. *resima* sp. nov.
   Carapace not spiny and with antero-lateral angle produced and strongly downbent .. .. *bidens* Fage

8. Exopod of uropod one-third as long as endopod (not including terminal spines in lengths); spine of exopod reaching to distal end of endopod. Fifth pleon somite subequal in length to telsonic somite *macrodactylus* Fage
Exopod of uropod one-fourth as long as endopod and with its terminal spine reaching beyond distal end of endopod. Fifth pleon somite distinctly longer than telsonic somite .. .. .. *leopardina* sp. nov.

SCHIZOTREMA ACULEATA Hale.

Schizotrema aculeata Hale, 1945, p. 168, fig. 16 (ref.)

This species proves to be not uncommon in south-western Australia. At Garden Island it was taken in company with *S. leopardina*, but the smaller size and characteristic armature enabled the species to be separated with ease. Males are available also from North-West Cape.

SCHIZOTREMA LEOPARDINA sp. nov.

Adult male. Integument well calcified. Cephalothorax and pleon with no conspicuous armature, but with minute, rather scattered, short spines; carapace with a few short hairs.

Fig. 5. *Schizotrema leopardina*, type male; lateral view and cephalothorax from above (× 45).

Carapace depressed (one-third as wide again as deep), three-fourths as long again as deep, twice as long as exposed pedigerous somites together and a little less than two-fifths of total length of animal; at the rear it is slightly raised dorsally and is produced backwards to partly cover the dorsum of the first free pedigerous somite; the branchial regions are somewhat swollen, delimited above by a shallow groove; to the rear of each eye there is a low conical elevation; antero-lateral angle produced and acute.

First and second free pedigerous somites subequal in width, neither as wide as the carapace.

Fifth pleon somite distinctly longer than telsonic somite, which is as long as wide, and has no terminal spine.

First antenna with first joint of peduncle longer than second and third joints together; the two-jointed flagellum is fully as long as the distal joint of peduncle.

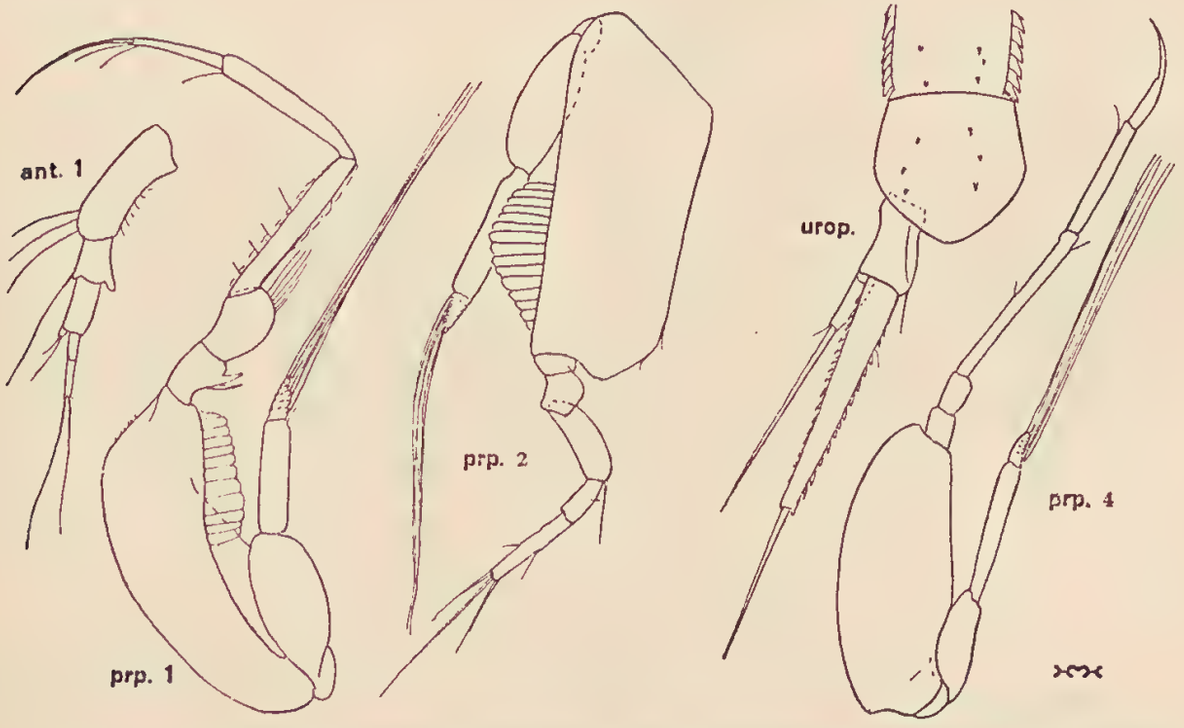


Fig. 6. *Schizotrema leopardina*, paratype male; ant. 1, first antenna; prp. 1, 2 and 4, first, second and fourth peraeopods; urop., telsonic somite and uropod (all × 90).

Lateral margins of ischium and merus of third maxilliped with strong, spine-like serrations.

Basis of first peraeopod two-thirds as long as rest of limb and with external lamellate spines; propodus a little shorter than carpus and nearly twice as long as dactylus; ischium with two or three curved spines on outer margin.

Basis of second peraeopod longer than rest of limb and furnished with lamellate spines; carpus as long as dactylus and twice as long as propodus; longest terminal dactylar spine longer than propodus and dactylus together.

Peduncle of uropod distinctly more than half as long as telsonic somite and two-fifths as long as endopod, exclusive of its terminal spine; exopod two-thirds as long as peduncle, one-fourth as long as endopod and with its terminal spine reaching a little beyond distal end of endopod; terminal spine of endopod two-thirds as long as the ramus.

Colour pale yellow with large conspicuous patches of brown pigment on carapace as shown in fig. 5; the lower edge of the carapace is broadly margined with yellow. Lateral parts of pedigerous somites brown. Peduncle of exopods of third maxillipeds and peraeopods brown, margined with the pale ground colour. Pleon and rest of appendages pale. Length 1·85 mm.

Loc. Western Australia: Garden Island, Careening Bay, 3 fathoms (type loc., A. G. Nicholls, submarine light, Nov., 1946); North-West Cape, Vlaming Head, 2 fathoms, on sand (G. P. Whitley, submarine light, Nov. 1945). Type in South Australian Museum, Reg. No. C.3138.

Over three hundred specimens, all males, were taken at Garden Island by Dr. Nicholls during the night of November 26th-27th. *S. aculeata* Hale was taken in the same locality but the new species is distinguished by the slightly larger size, the absence of pronounced body armature, the longer fifth pleon somite, the different proportions of the terminal joints of first and second peraeopods, and of the uropod, where the exopod is relatively much shorter (half as long as endopod in *aculeata*, only one-fourth in *leopardina*). Above all the striking colour pattern enables the new species to be distinguished at a glance from all other Australian Nannastacids; the bold pigment patches persist in spirit material.

SCHIZOTREMA RESIMA sp. nov.

Adult female. Integument well calcified. Dorsum and sides of cephalothorax with rather large spines, many of which bear a brush of minute setae in distal third. Pleon somites with dorsal spines and with hyaline lateral serrations.

Carapace with branchial regions swollen, so that it is fully as wide as deep; it is robust, being only one-third as long again as deep, is twice as long as the pedigerous somites together and two-fifths of total length of animal; the pseudorostral lobes are spinose inferiorly, are rather prominent and upturned, and the rostral siphons are long; the antero-lateral angle is well produced and is spinose.

First pedigerous somite exposed, but short, particularly on dorsum; this, like second and third somites, is as wide as carapace, the fourth and fifth being abruptly narrower.

Fifth pleon somite equal in length to telsonic somite, which has dorsal spines but no spine at hinder margin and is fully as wide as long.

First antenna with first joint of peduncle as long as second and third segments together.

Fig. 7. *Schizotrema resima*, type female; lateral view and cephalothorax from above (× 60).

Third maxilliped with well-developed exopod.

First peraeopod short, the basis only half as long as rest of limb; carpus and propodus equal in length, each twice as long as dactylus.

Basis of second peraeopod subequal in length to rest of limb; carpus as long as dactylus and less than twice as long as propodus; longest dactylar spine almost as long as dactylus and propodus together.

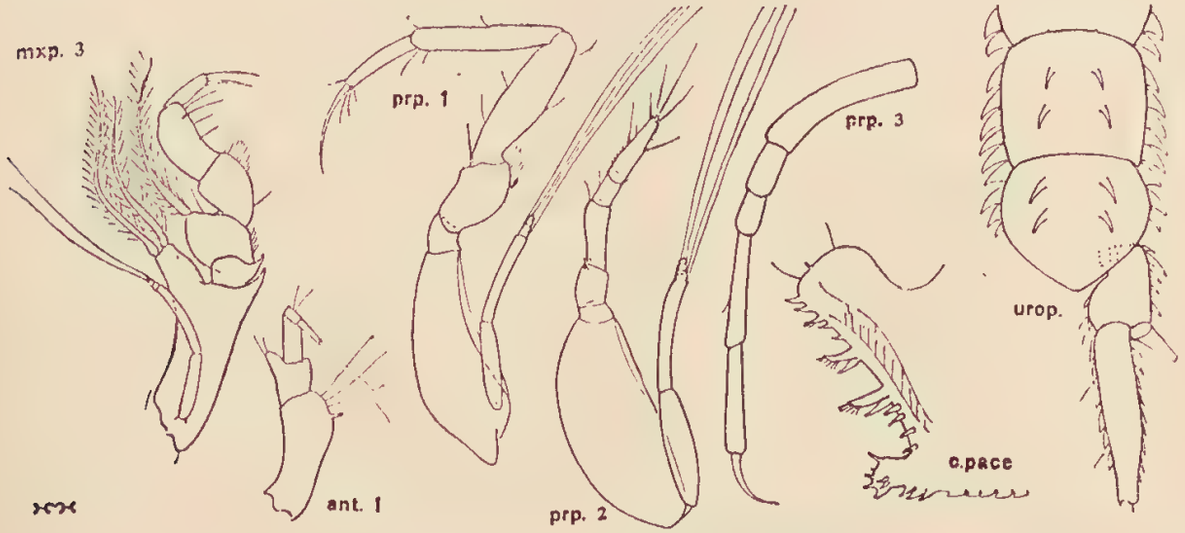


Fig. 8. *Schizotrema resima*, type female; ant. 1 and mxp. 3, first antenna and third maxilliped; prp. 1–3, first, second and third peraeopods; urop., uropod with fifth pleon and telsonic somites (all × 125).

Peduncle of uropod distinctly more than half as long as telsonic somite and less than half as long as endopod, the terminal spine of which is missing; exopod two-sevenths as long as endopod and with terminal spine missing.

Colour uniformly white. Length 1·15 mm.

Loc. Western Australia: Garden Island, Careening Bay, 3 fathoms (A. G. Nicholls, submarine light, Nov., 1946). Type in South Australian Museum, Reg. No. C.3138.

Genus CUMELLA Sars.

Two of the Western Australian species described by Zimmer (1914, pp. 181-182) viz. *gibba* and *cyclaspoides* are not represented in the material now in hand, notwithstanding the fact that their type locality, Shark Bay, was well combed by G. P. Whitley in 1945.

CUMELLA HISPIDA Calman

Cumella hispida Calman, 1911, p. 347, pl. xxxii, fig. 11–14; Zimmer, 1914, p. 179; Fage, 1945, p. 209, fig. xxxi; Hale, 1945, p. 176, fig. 21.

A single male from the Mary Anne Group, north-western Australia (G. P. Whitley, 3½ fathoms, Nov. 1945) agrees with the males previously described from Queensland (Hale *ut supra,* urop. ♂ and prp. 5 ♂). Zimmer records the species from Western Australia—Shark Bay and Rottnest Island.

CUMELLA MICHAELSENI Zimmer.

Cumella michaelseni Zimmer, 1914, p. 179, fig. 4–5.

A male 2·5 mm. in length, and taken by G. P. Whitley at the type locality (Shark Bay, Western Australia, 1½ fathoms, Nov. 1945), resembles in general appearance the males of both *hispida* Calman and *turgidula* Hale.

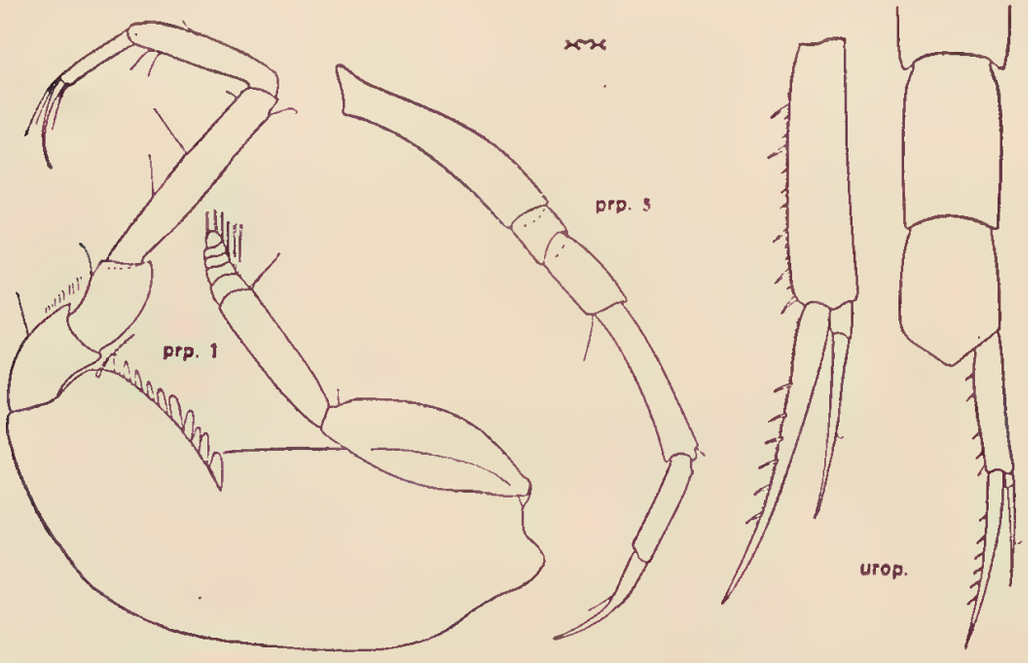


Fig. 9. *Cumella michaelseni,* adult male; prp. 1 and 5, first and fifth peraeopods (× 120); urop., uropod (× 120); uropod with fifth pleon and telsonic somites (× 54).

In a key previously submitted (Hale, 1945, p. 171) it was not possible to separate the males of *hispida* and *michaelseni,* only the female of the last-named being then known. Though distinguished by relatively trivial characters, adult males of the three species are separable thus:

1. Terminal spines of rami of uropods distinctly marked off. Peduncle of uropod slightly longer than endopod including terminal spine *turgidula* Hale
   No demarkation between rami of uropods and their terminal spines. Peduncle of uropod five-sixths as long as endopod 2
2. Carpus of fifth peraeopod twice as long as propodus. Exopod of uropod more than three-fourths as long as endopod .. .. *hispida* Calman
   Carpus of fifth peraeopod only half as long again as propodus. Exopod of uropod less than three-fourths as long as endopod .. *michaelseni* Zimmer

CUMELLA SIMILIS Fage.

Cumella similis Fage, Feb. 1945, p. 211, fig. xxxiii–xxxiv.
Cumella munroi Hale, June 1945, p. 171, fig. 17–18.

I can find no valid differences between the Southern Queensland material recorded as *munroi* and that described at about the same time by Fage from Annam.

The species proves to be not uncommon at Garden Island in Western Australia, where 200 males and 3 females were collected by A. G. Nicholls.

CUMELLA CANA Hale.

Cumella cana Hale, 1945, p. 172, fig. 18 (syn.).

A single not fully adult male was taken at Garden Island.

Genus CUMELLOPSIS Calman.

Cumellopsis Calman, 1904, p. 28, and 1906, p. 418; Stebbing, 1913, p. 177; Hansen, 1920, p. 32.

CUMELLOPSIS AUSTRALIENSIS sp. nov.

Female with developing marsupium. Integument thin but well calcified, opaque and brittle; armature of appendages hyaline. Carapace with strong imbricate surface patterning, rest of body obscurely granulate.

Carapace one-third of total length of animal, slightly depressed and fully half as long again as deep; a low, irregular, median dorsal double carina runs from ocular lobe to a marked tumidity at hinder end; the last-named elevation is minutely bifid at the proximal end and at its front there is a pair of tubercles; just posterior to the termination of each pseudo-rostral suture there is a shallow

pit; each side of the carapace is shallowly indented for the greater part of length of carapace and the hollow is margined below by a sharply defined, horizontal, carina arising at the antero-lateral angle and terminating at the postero-lateral angle, which is produced backwards to form a small subtriangular lobe; the branchial regions are somewhat swollen and each is traversed by a fine carina, which arises at the posterior end of lateral hollow and curves upwards to meet the median posterior swelling; outline of back as seen from the side only slightly arched from posterior tumidity to ocular lobe, sinuate because of

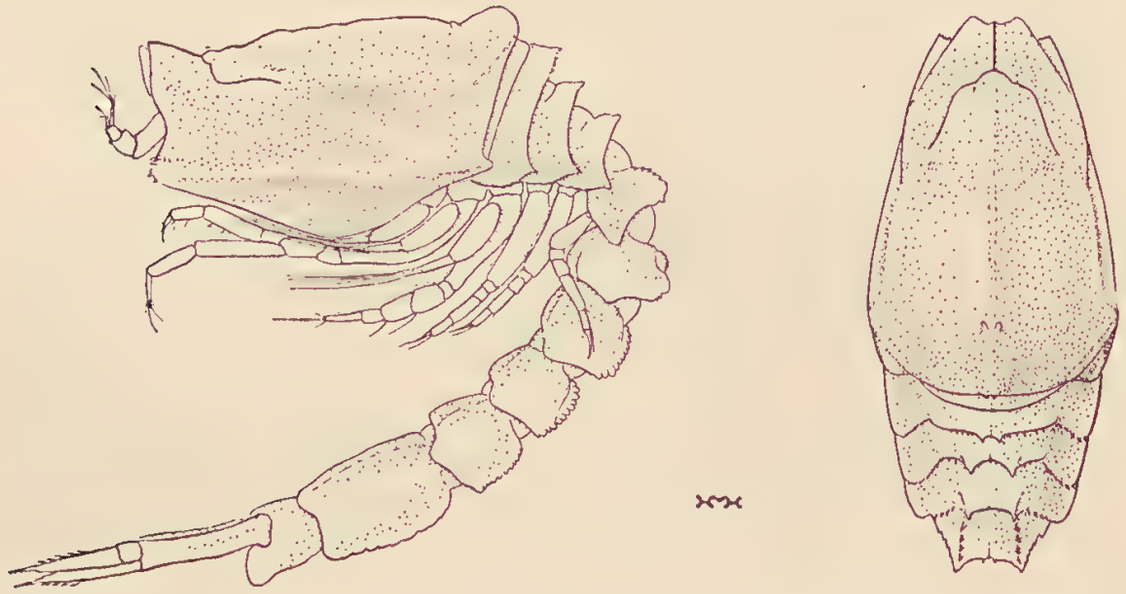


Fig. 10. *Cumellopsis australiensis*, type female; lateral view and cephalothorax from above (× 36).

the irregularity of dorsal carina; the rear end of carapace overhangs the pedigerous somites only slightly. Pseudorostrum abruptly upturned, the lobes meeting for a distance equal to almost one-seventh of length of carapace; each is truncate and slightly concave in front when viewed either from above or from the side. Ocular lobe moderately large, tumid, more than twice as broad as long and without apparent lenses. Antero-lateral margin slightly concave; antero-lateral angle prominent, subacutely rounded, and furnished with a blunt hyaline tubercle and two or three spines.

Pedigerous somites together distinctly more than half as long as carapace; first somite short, almost smooth and with pleural parts concealed; second to third subequal in length, with hinder edges finely crenulate (in part almost spinulose) and with a pair of feeble dorsal ridges, each of which terminates at hinder margin in a small triangular projection; the postero-lateral angles of these three somites are subacutely produced backwards; fifth somite slightly

longer than fourth; with a pair of minute projections at middle of hinder margin, a feebly serrate dorso-lateral carina on each side, and with postero-lateral angles as in preceding somites, but less acute.

Pleon equal in length to cephalothorax; first three somites subequal in length, with an elevated, feebly serrate dorso-lateral carina on each side; seen from above these ridges curve outwards and so diverge rather widely at the rear; fourth somite also with a pair of dorso-lateral ridges for whole length, but here they are parallel; fifth somite nearly twice as long as fourth, with a median dorsal carina, crenulate and almost cristiform, and projecting a little beyond posterior margin; the first five somites bend inwards rather abruptly infero-laterally, so producing a distinct though rounded angle between the sides and the somewhat flattened venter; telsonic somite about as long as fourth, with a low median carina on anterior half of dorsum, and with posterior margin bisinuate, rounded medianly; the telsonic part of the somite overhangs the bases of the uropods.

First antenna geniculate between the wide first and second segments of peduncle; first joint twice as long as second and third joints together; third only half as wide, and not much more than half as long, as second; flagellum little longer than third peduncular segment, composed of two joints, the first longer than second; accessory lash single-jointed, less than half as long as main flagellum.

Third maxilliped (like peraeopods) with transparent marginal teeth as shown in figure; basis equal in length to remaining joints together, not at all expanded distally and with outer subapical setae very long; carpus fully half as long again as propodus, which is twice as long as dactylus.

First peraeopod short, the propodus of extended limb reaching only to antero-lateral angle of carapace; basis less than two-thirds as long as rest of limb; carpus two-thirds as long again as propodus, which is almost twice as long as dactylus.

Second peraeopod three-fourths as long as first; basis a little shorter than rest of limb; ischium distinct; merus and carpus broad, subequal in length; each a little shorter than the tapering dactylus, which is distinctly more than twice as long as propodus.

Basis of third peraeopod not much shorter than rest of limb, in second distinctly shorter than this, and in fifth not much more than half the combined lengths of remaining joints. Carpus of posterior limbs nearly twice as long as propodus, and considerably longer than ischium and merus together; dactylus longer than propodus, slender and tapering in distal half; the single distal propodal seta is thin and does not reach tip of dactylus; other setae of third to fifth legs insignificant.

Peduncle of uropod carinate (or rather roof-shaped) dorsally, about as long as fifth pleon somite and not much shorter than the equal rami, including the terminal spines in the length of the latter; the distal spines are not distinctly marked off and the edges of the rami are in part serrate.

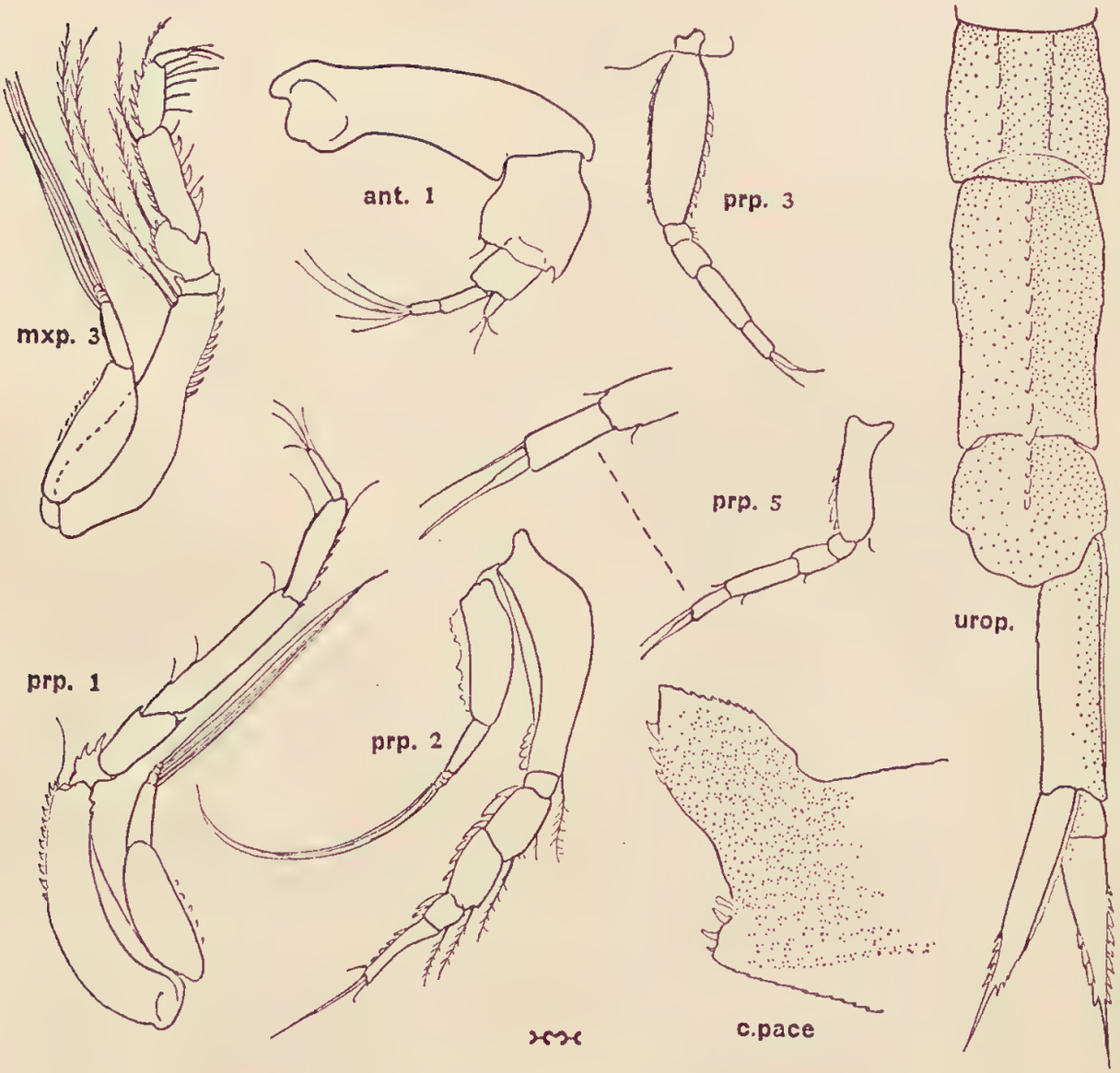


Fig. 11. *Cumellopsis australiensis*, type female; c.pace, anterior part of pseudorostral lobe (× 77); ant. 1, first antenna (× 170); mxp. 3, third maxilliped (× 77); prp. 1–3 and 5, first, second, third and fifth peraeopods (× 77; distal joints of fifth leg, × 170); urop., uropod with fourth, fifth and telsonic somites of pleon (× 77).

Colour white, without trace of pigmentation anywhere. Length 3·0 mm.

Loc. New South Wales: off Ulladulla, 80 metres, on coarse sand (K. Sheard, Jan. 1944). Type in South Australian Museum, Reg. No. C.2836.

This is the first member of the genus to be recorded for the Southern

Hemisphere. It differs in a number of important features from the only other two species of the genus, notably in the marked dorsal elevation at posterior end of carapace, the sculpture, the short first peraeopods and the equal rami of the uropod.

Genus CAMPYLASPIS Sars.

It would seem from the large number of Australian Cumacea examined to date that this genus is poorly represented on the southern and western coasts. Off the eastern and Tasmanian shores thirteen species have been recorded (Foxon, 1932, p. 293 and Hale, 1945, p. 180 *et. seq.*), two are known to occur in South Australia (Hale, 1945, pp. 187 and 192), while only four specimens, representing three species, appear amongst the thousands of Western Australian specimens now in hand.

C. echinata Hale, was described from the male only; the adult female has since been found not far from the type locality in New South Wales and details of this sex are given below.

Two described species of the genus are not included in the key previously submitted by the writer (Hale, 1945, p. 181). These are *squamifera* Fage (1929, p. 19, pl. ii, fig. 38–45—omitted from Zoological Record), and *tubulata* Fage (1945, p. 215, fig. 36–38). *C. squamifera* would be separated in the key from *globosa* Hansen by the character of the merus of the third maxilliped and the shorter peduncle of the uropod. *C. tubulata* would fall near *unisulcata* and differs in having (1) the merus of the third maxilliped shorter instead of longer than the carpus and propodus together; (2) the merus of the first peraeopod shorter than the carpus.

CAMPYLASPIS UNISULCATA Hale.

Campylaspis unisulcata Hale, 1945, p. 187, fig. 27–28.

A single young male from Rottnest Island (A. G. Nicholls, Nov. 1945) is referred here with some doubt; it is only 2·8 mm. in length and the appendages are not fully developed. Previously recorded from South Australia and Tasmania.

CAMPYLASPIS MINOR Hale.

Campylaspis minor Hale, 1945, p. 197, fig. 35–36.

Two examples from Shark Bay and North-West Cape (G. P. Whitley, Nov. 1945).

CAMPYLASPIS cf. SIMILIS Hale.

Campylaspis similis Hale, 1945, p. 186, fig. 26.

A juvenile male from the Mary Anne Group (G. P. Whitley, 3½ fathoms, Nov. 1945) apparently is referable to either *thompsoni* Hale or *similis* Hale; it is so young, however, that certain identification is not possible.

CAMPYLASPIS ECHINATA Hale.

Campylaspis echinata Hale, 1945, p. 204, fig. 41–42 (male only).

Adult female. The carapace, pedigerous and pleon somites, and the uropods bear numerous spiniform projections as in the male; these have rounded tips, mostly slightly dilated and in a few cases bifid; the shallow lateral depression is somewhat larger than in male.

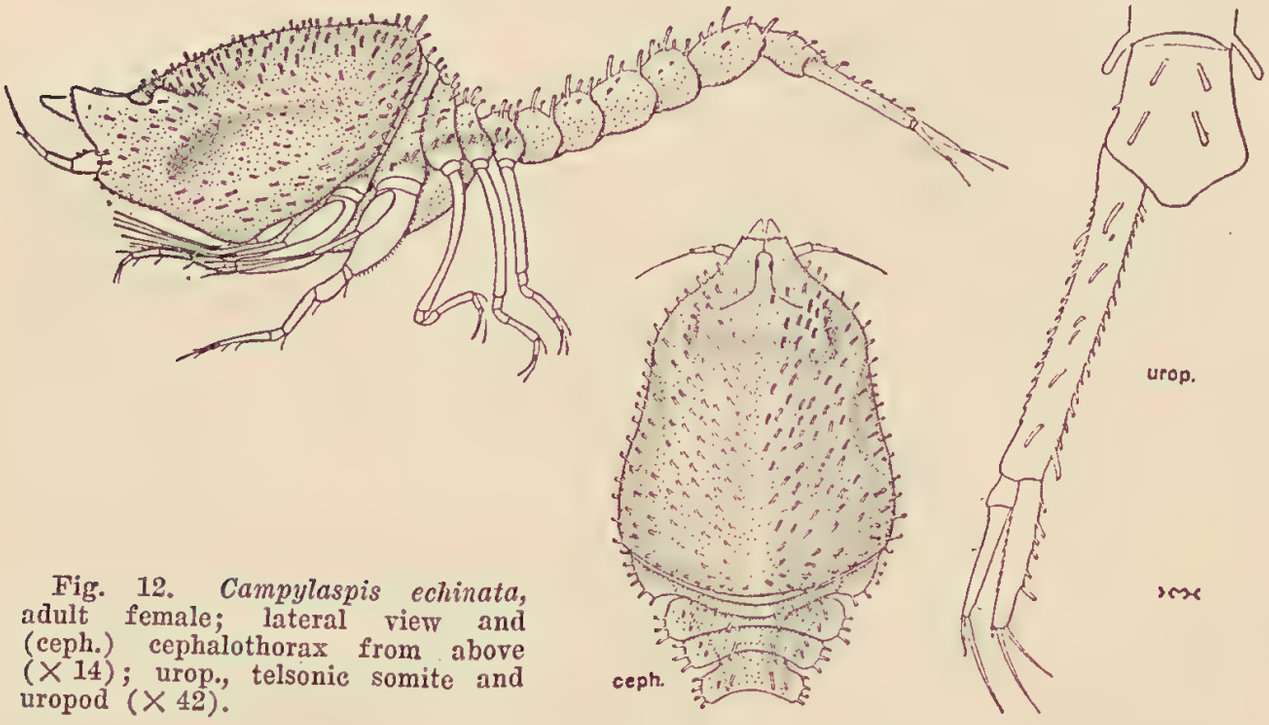


Fig. 12. *Campylaspis echinata*, adult female; lateral view and (ceph.) cephalothorax from above (× 14); urop., telsonic somite and uropod (× 42).

Carapace twice as long as pedigerous somites together, one and three-fourths times as long as deep, and more than one-third as wide again as deep (it is less depressed in the male). Antennal notch shallow and antennal angle rounded. Pseudorostral lobes widely truncate in front and meeting for a distance equal to width of ocular lobe, which is fully twice as long as wide, very slightly narrower than in male.

First pedigerous somite, except for pleural parts, exposed only as a narrow strip.

Pleon a little shorter than carapace (slightly longer than carapace in male); the fourth, fifth and telsonic somites each bear a fine median longitudinal carina on the dorsum.

Basis of third to fifth peraeopods very elongate, in all distinctly longer than remaining joints together.

Peduncle of uropod barely twice as long as telsonic somite and about two and one-third times as long as endopod, which is barely longer than exopod; in the male the endopod and peduncle are relatively a little longer.

Colour yellow. Length 4·6 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fathoms, in fine silt on flathead grounds (D. Rochford, A. trawl, Jan. 1945).

SUMMARY

The Nannastacids dealt with are mostly from Western Australia, for which fourteen species are listed, including four which are new, *viz. Nannastacus nichollsi, N. vietus, Schizotrema leopardina* and *S. resima.*

Cumellopsis australiensis sp. nov. is described from New South Wales and details are given of the hitherto unknown female of *Campylaspis echinata* Hale.

REFERENCES CITED.

Calman, W. T. (1911): "On New or Rare Crustacea of the Order Cumacea from the Collection of the Copenhagen Museum. Part ii. The Families Nannastacidae and Diastylidae." *Trans. Zool. Soc.*, xviii, pp. 341–398, pl. xxxii–xxxvii.

Fage, Louis (1929): "Cumacés et Leptostraces provenant des Campagnés scientifiques de S.A.S. le Prince Albert Ier de Monaco." *Rés. Campagnés Sci.*, LXXVII, pp. 1–56, pl. i–iii.

Fage, Louis (1945): "Les Cumaces du Plancton nocturne des cotes d'Annam." *Arch Zool. Exp. et. Gen.*, pp. 165–223, fig. 1–42.

Foxon, G. E. H. (1932): *Great Barrier Reef Exped.*, 1928-29, *Sci. Rep.*, iv, No. 11, pp. 387-395, fig. 5–10.

Hale, Herbert M. (1937): "Further Notes on the Cumacea of South Australian Reefs," *Rec. S. Aust. Mus.*, vi, pp. 61–74, fig. 1–9.

Hale, Herbert M. (1945): "The Family Nannastacidae." *Rec. S. Aust. Mus.* viii, 1945, pp. 145–218, fig. 1–49.

Hansen, H. J. (1920): Crustacea Malacostraca iv. The Order Cumacea. *Danish Ingolf-Exped.*, iii, pt. 6, pp. 1–74, pl. i–iv.

Stebbing, T. R. R. (1913): Cumacea (Sympoda). *Das Tierreich*, Lief. xxxix, pp. 1–210, fig. 1–137.

Zimmer, Carl, 1914): *Fauna Südwest Aust.*, v, Cumacea, pp. 175–195, fig. 1–18.

The LIFE CYCLE of the TREMATODE *ECHINOPARYPHIUM ELLISI*, from the BLACK SWAN

By T. HARVEY JOHNSTON and L. MADELINE ANGEL, University of Adelaide.

Fig. 1–3.

The larval stage, *Cercaria ellisi* Johnston and Simpson (1944, 125–128), was described from *Lymnaea lessoni* from the Murray River Swamps at Tailem Bend. It was reported to have been identified on twelve occasions between May 1937 and March 1943, the months being those of autumn, spring and summer. On those occasions, the parasite was found in 156 of 2,064 *Lymnaea* examined, i.e. in 7·5 p.c., but these figures do not take into consideration the numbers of that species of pond snail collected from the swamps on other occasions when *C. ellisi* was not recognized. Since those observations were made we have identified the cercaria in 561 of 2463 *L. lessoni*, i.e. in about 23 p.c., but this increase in percentage was due to collections made on three successive occasions, January to April 1947, 32 of 291 being parasitized in January, 210 of 363 in March, and 197 of 507 in April, a total of 439 out of 1,161 snails examined, i.e. about 38 p.c. On other occasions we found only one of 342 and 4 of 365 infected.

The habitat preferred by the black swan, *Chenopis atrata*, which we now know to be the host for the adult stage of the trematode, no doubt affects the distribution of parasitized *Lymnaea*. The bird prefers open, relatively shallow water and feeds on vegetation Second intermediate molluscan hosts living on such vegetation would also be ingested. Chance is thus an important factor in assessing percentage infection of swamp snails.

C. ellisi is a 45 spined echinostome with its body provided with spinules dorsally and ventrally as far back as the level of the acetabulum. The spines are in two rows, those of the aboral series being slightly longer than those of the oral, and are about the same length as those in the groups of corner spines. The cyst stage (118–133 μ, diameter) was obtained experimentally from the mantle cavity of the following molluscs: *Amerianna* spp., *Lymnaea lessoni*, *Planorbis isingi*, *Plotiopsis tatei* and *Corbiculina angasi*, as well as in the kidneys of the tadpole of *Crinia signifera*.

It was reported that faecal material deposited by a pelican had been used in midsummer in an endeavour to infect various kinds of pond snails; 92 days later two of the *Lymnaea* were observed giving off *Cercaria ellisi* and numerous cysts of the parasite were found in the tissues of these laboratory-bred snails. Since adult echinostomes possessing 45 spines had not been found in Australian

pelicans, but the water hen, *Gallinula tenebrosa*, had been recorded as the host for a 44 (?45) spined species it was suggested that the faeces might have been contaminated. Contamination of that faecal material with faeces previously deposited on the bank by a black swan would provide the explanation of the finding of *C. ellisi.*

In April 1947 we discovered a number of 45-spined *Echinoparyphium* flukes in the upper portion of the small intestine of a black swan from the Tailem Bend Swamps, and our former colleague, A. C. Beckwith, utilized some of the eggs from the duodenal contents for infection experiments with the following results: of 11 *Lymnaea lessoni,* three gave off *C. ellisi,* four contained many rediae and daughter rediae (with some mature cercariae) at their death, and four were not infected. The snails were isolated for testing for the first time 110 days after they were placed in contact with the *Echinoparyphium eggs,* and on this day one *Lymnaea* was giving off the cercariae; five of the other *Lymnaea* died within four days of this date, and all of these contained large numbers of rediae, while some had mature cercariae. The remaining snails were tested at weekly intervals, and in a fortnight two of them were giving off cercariae (125 days). From this it seems probable that the time taken to reach maturity was not much less than 110 days, although this had not been verified by testing. On 29th October 1947, we repeated the experiment, using eggs from the duodenal contents of a swan in which many specimens of *Apatemon intermedium* but only one egg-bearing *Echinoparyphium* were present in that region. By 1st December (i.e. 33 days later), seven *Lymnaea* were dead and showed no evidence of infection when examined under the dissecting microscope. On this date the four remaining *Lymnaea* were removed to a fresh aquarium, so that they had no further contact with the eggs or possible miracidia. From 6th January 1948, the snails were isolated twice weekly, and on 16th January (i.e. 79 days) one of them was giving off *C. ellisi.* The other three *Lymnaea* did not become infected.

On 1st December eight *Lymnaea,* and on the following day six more, were placed in contact with eggs from the original material, either in small dishes or in the tank from which the four original *Lymnaea* had been removed. None of these became infected. One can conclude from the foregoing that the miracidia had hatched before 1st December, that is, within 32 days of the time that the eggs had been removed from the intestine. The time of hatching of miracidia under natural conditions might be slightly less than this period, since it could be expected that it would take a day or two for the developing eggs to have been passed in the faeces and reach the swamp water.

The somewhat scanty data at our disposal also suggests that an infection takes longer to reach the cercaria-producing stage in autumn than it does in

spring or early summer: of the snails exposed to infection in May, one took not more than 110 days, two not less than 119 days, while two snails exposed at the end of October took not less than 77 days and 79 days respectively; two snails exposed during January 1943 gave off cercariae within 90 days (perhaps 84 days, since testing was done weekly).

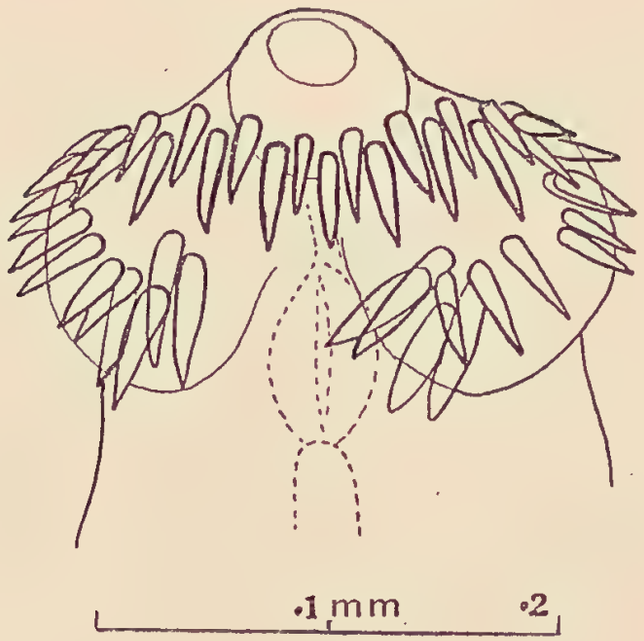
At the same time as eggs from the duodenal contents were used, another experiment was set up, using about 100 eggs which had been dissected out from several adult *Echinoparyphium,* but it would appear that such eggs are not viable or infective since none of the six *Lymnaea* exposed became infected.

Although we have obtained cercariae experimentally in August and September, we do not collect many *Lymnaea* from the swamps before December, and in the few which have been collected we have not recorded infections of *C. ellisi.* We have found *C. ellisi* in two of a total of 82 snails obtained in October since 1937. On 18th September 1940, 15 *Lymnaea* collected were apparently uninfected; they were retested on 14th November, when one of them was giving off *C. ellisi.*

C. ellisi was recognized from *Simlimnea subaquatilis* from Lake Alexandrina (Johnston and Beckwith, 1946, 125), but has not yet been identified from any snail host other than the two Lymnaeidae mentioned. Though we have attempted to infect *Planorbis isingi* and *Amerianna* spp. our results have been negative and our examination of thousands of these snails collected under natural conditions in the localities where *Lymnaea* infected with *C. ellisi* was found, has failed to reveal the presence of these cercariae in any of them, we can safely conclude that they are not normal hosts for the cercarial stage, though the cercariae readily enter these molluscs and become encysted as metacercariae in them.

Johnston and Simpson (1944) noted the differences between *C. ellisi* and *C. clelandae,* a 45-spined echinostome whose host is *Planorbis isingi. C. clelandae* could not be made to encyst in tadpoles, a normal secondary intermediate host of *C. ellisi,* and its cysts were consistently 30μ larger in diameter. The fact that we were unable to infect *Planorbis* with *Echinoparyphium ellisi* at the same time that we infected *Lymnaea,* provides further evidence that the two cercariae are distinct. In our original account (Johnston and Angel, 1939) of *C. clelandae* we stated in error that the oral spines were slightly larger than those of the aboral series whereas the figure (fig. 8) shows the true condition, i.e. that the aboral spines are the longer. *C. clelandae* is the larva of an unrecognized *Echinoparyphium.*

Attempts to obtain the adult of *E. ellisi* experimentally by feeding cysts to a pigeon and a young fowl were unsuccessful.



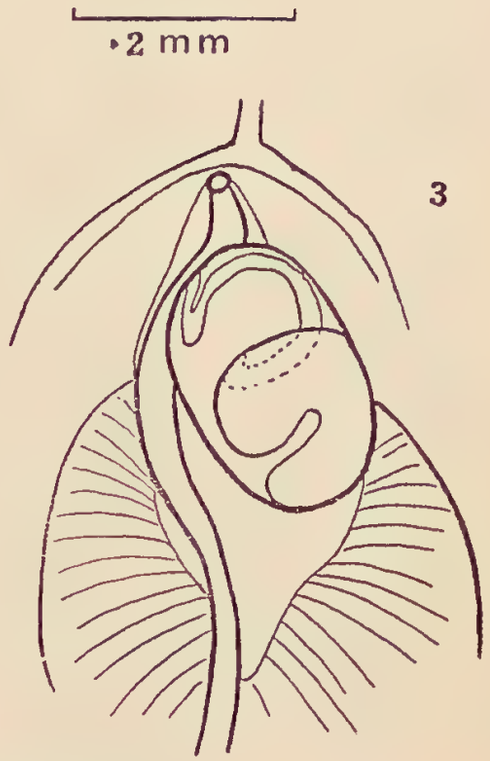


Fig. 1. *Echinoparyphium ellisi*, seen from dorsal surface. 2. Head region. 3. Cirrus sac and metraterm, dorsal.

ADULT STAGE.

The adult worm lives in the duodenum and upper part of the succeeding portion of the small intestine of the black swan, *Chenopis atrata*. Very young forms suggestive of recently liberated metacercariae were collected along with adults in October and April at Tailem Bend, South Australia. Preserved adults vary in form, being short and broad or long and narrow, the former condition probably being the more normal. The following measurements in millimetres (unless otherwise indicated) were made on egg-bearing worms of the former type.

Length 2·1–3·4, usually about 3 mm.; maximum breadth at acetabulum ·4–·6, at collar ·33–·39, breadth nearly uniform from level of acetabulum to that of posterior testis; posterior end tapering to become bluntly rounded; body minutely spiny dorsally and ventrally as far back as region of acetabulum; preacetabular portion commonly with ventrally infolded margins and bent ventrally so that both suckers tend to approximate. Collar with 45 sharp-pointed spines, including four stouter spines in each ventral corner and arranged more or less in two pairs; corner spines ·063–·069mm. by 13·4μ; remainder in two rows; ventral (oral) spine next each corner group ·052mm. by 9·6μ, succeeding spines ·053 mm. by 11·5μ (aboral), ·055 mm. by 13·4μ (oral) and ·052 mm. by 9·6μ, so that the marginal spines of the oral series tend to be rather larger and wider than the aboral spines which alternate with them; dorsal spines of oral series ·048 mm. by 9·6–11·5μ, those of aboral series larger, stouter, ·053 mm. by 11·5μ. Oral sucker spherical, ·11–·16 mm., or slightly longer than broad. Acetabulum in second quarter or fifth of body length, ·33–·462 long by ·30–·38 wide with rather deep concavity. Ratio of length of oral and ventral suckers 1:2·5–3·5; ratio of width 1:2–3. Postacetabular region about three-fifths body length. Prepharynx short, ·06 mm. long; pharynx ·088–·11 long, ·033–·06 broad; oesophagus long, ·33–·65, narrow; crura long, narrow, slightly sinuous, terminating some distance in front of end of body.

Testes in tandem, contiguous, elliptical with broad ends, in posterior half of body; anterior ·165–·35 long, ·13–·22 wide; posterior ·165–·44 long, ·13–·22 wide; posterior ·165–·44 long, ·13–·2 wide; both almost touching crura; post-testicular region about one fifth body length. Cirrus sac relatively short, rounded, ·22 by ·143–·165, obliquely placed, with posterior portion overlying front of acetabulum, with large twisted tubular inner seminal vesicle in posterior half of sac, succeeded by narrow cirrus lying bent in anterior part of sac. Genital pore almost median, just behind intestinal bifurcation; atrium with rather thick muscular walls.

Ovary near midlength of body, to one side of midline, spherical, ·09–·13; oviduct curving backwards and inwards to enter shell-gland complex where it receives narrow, very short, common yolk duct; uterus soon widening and thrown into one or two loops behind ovary and below shell gland, then passing forward beside or below ovary before becoming arranged in a few coils in region between ovary and acetabulum; metraterm muscular, passing above acetabulum near midline or to one side of it, eventually travelling beside or below front part of cirrus sac to enter atrium. Eggs broadly elliptical, ·0875–·1 mm. long, ·065–·075 wide, usually 12–30 (occasionally nearly 50) in uterus. Yolk glands not reaching level of acetabulum but extending nearly to posterior end of worm, i.e. a short distance beyond crura; follicles numerous, small, irregularly rounded, occupying zone dorsally and ventrally from body margins inwards to cover crura; vitelline fields joining in portion of post-testicular region; transverse yolk duct relatively wide, irregular, lying just in front of or dorsally to anterior testis and above shell gland. Latter compact, extending almost from one crus to the other and from anterior testis to ovary.

The youngest stage obtained from the duodenum of the host was ·47 mm. long, ·12 mm. wide at collar, ·112 at acetabulum; oral sucker ·05, acetabulum ·075 diameter, sucker ratio 2:3; posterior end acetabulum at ·3 mm. from head end of worm, postacetabular region ·15 mm., i.e. nearly one-third body length; pharynx ·03 long, ·02 wide. Another very young worm was ·66 long, ·154 wide at collar, ·165 at acetabulum; oral sucker ·062, acetabulum ·11 diameter, ratio nearly 1:2; postacetabular region ·26, thus more than one-third body length. Another specimen was ·815 long, ·143 wide at collar, ·154 at acetabulum; oral sucker ·055, acetabulum ·112, sucker ratio 1:2; postacetabular region ·32, about 2:5 of body length. A worm, 1·1 mm. long, was ·264 wide at acetabulum; oral sucker ·077 long by ·066 wide, acetabulum ·154 diameter, ratio of widths 3:7; preacetabular region ·6, postacetabular about ·35. In a specimen 1·32 mm. long the postacetabular length was ·66, just half the total length. Another worm, 1·54 mm. long, ·33 wide at acetabulum, had oral sucker ·088 long by ·066, acetabulum ·22 diameter, sucker ratio (width) 3:10, postacetabular length just half that of body. In a specimen 1·87 long by ·385 wide the oral sucker was ·088 and acetabulum ·275 long by ·264, and postacetabular region ·964, i.e. just over half body length.

In a worm 1·48 long, a small cirrus sac was already differentiated, while in one, 1·59 long by ·3 wide, testes, ovary, uterus and cirrus sac were recognizable. A specimen 1·8 long by ·33 had comparatively few yolk glands, but they were conspicuous and were arranged in a single linear series along each crus. With increasing length of parasites, these glands became much more

numerous and the vitelline fields more extensive. The smallest, and apparently youngest, egg-bearing worms were 2·0–2·2 mm. long and these contained only two or three eggs. One worm, 2·1 mm. long by ·35 wide was not yet ovigerous, but another of the same length but of greater breadth (·374) contained a few eggs. Sexual maturity thus becomes established when the worms reach about 2 mm. in length. Many eggs were present in some specimens 2–3 mm. long.

In a young worm 1·6 mm. long the corner spines were ·065–·069 mm. long by ·011; the marginal ·038–·046 by 7·6μ, those of the two series being subequal; and the aboral dorsal spines ·057 mm. by 9·6μ and the oral dorsals ·04–·042 mm. by 7·7μ.

Verma (1936, 155) published a brief unfigured account of *Echinoparyphium gizzardai* from the gizzard of the black swan, his specimens being obtained from the Calcutta School of Tropical Medicine, where Dr. P. A. Maplestone was a member of the staff. This latter officer collected parasitic material whilst he was on the staff of the Australian Tropical Institute, Townsville; hence it is likely that the parasites came originally from North Queensland. As we have occasionally found in the gizzard of the black swan small cestodes which occur normally in the duodenum it is possible that trematodes from the latter situation may have wandered into the gizzard after the death of the host.

The reported dimensions of the worm and of its organs agree fairly well with those given by us for *E. cllisi,* but the acetabulum was stated to lie in the first fourth of the body length and there were only 22 collar spines, those at the angles (corner spines) being ·05 by ·015 mm., and others of two sizes ·042 by ·01 and ·0252 by ·09 mm. The small number of the spines was specially noted. Our form has 45 spines whose dimensions are different from those of *E. gizzardai.*

Verma also gave a very brief unfigured account of *Echinoparyphium* sp. from the intestine of the same bird host. Under this generic name he recorded some specimens as having 44 spines, those of the end groups measuring ·067 by ·0168 and ·042 by ·01, while the lateral and dorsal spines, ·0588 by ·122 mm., appeared to be arranged in couples; the ventral sucker was at one-fourth to one-fifth the body length; and eggs ·256 by ·588 (obviously an error for ·0256 and ·0588) to ·084 by ·05. Another specimen was stated to possess only 33 spines.

Our material agrees with Verma's *Echinoparyphium* sp. with 44 spines (probably an error for 45). The number of spines reported for *E. gizzardai* is probably also an error, since the genus has an uneven number. As there is so much agreement between *E. ellisi* and *E. gizzardai,* except in regard to the number and sizes of the spines, we consider it likely that a re-examination of

the Calcutta material would reveal synonymy. However, until that should occur we prefer to retain the specific name given originally to the cercarial stage and place *Echinoparyphium* sp. Verma (1936, 155–6) as a synonymy.

Typical adults of *E. ellisi* have been deposited in the South Australian Museum. We wish to acknowledge our indebtedness to the Commonwealth Research Grant to the University of Adelaide; and to Messrs. G. G., Fred, and Bryce Jaensch of Tailem Bend, and Mr. L. Ellis, also of Tailem Bend, for their generous assistance in regard to material.

SUMMARY.

Cercaria ellisi Johnston and Simpson 1944 from *Lymnaea lessoni* and *Simlimnea subaquatilis* from the Lower Murray region is the larval stage of *Echinoparyphium ellisi*. The second intermediate hosts are various species of freshwater molluscs; and tadpoles can also act as such under experimental conditions. Adult and growth stages from the upper intestine of the black swan, *Chenopis atrata*, are described, and the relation of *E. ellisi* to *E. gizzardai* Verma is discussed.

LITERATURE.

Johnston, T. H. and Angel, L. M. (1939): "Larval Trematodes from Australian freshwater Molluscs. Part VI." *Trans. Roy. Soc.*, S. Austr., lxiii, 1939, 200–203.

Johnston, T. H. and Beckwith, A. C. (1946): "Life cycle of the sheep liver fluke in South Australia." *Trans. Roy. Soc.*, S. Austr., lxx, 1946, 121–126.

Johnston, T. H. and Simpson, E. R. (1944): "Larval trematodes from Australian freshwater Molluscs. Part IX." *Trans. Roy. Soc.*, S. Austr., lxviii, 1944, 125–132.

Verma, S. C. (1936): "Notes on trematode parasites of Indian birds. Part I." *Allahabad Univ. Studies*, xii (12), 147–188.

A NEW *ATURIA* FROM THE TERTIARY OF SOUTH AUSTRALIA

By CURT TEICHERT AND BERNARD C. COTTON.

Plate xxi.

INTRODUCTION:

THE specimen of *Aturia* described here was obtained during an examination of the Christie's Beach section, Gulf St. Vincent. It was picked up by Mr. J. Eley, and kindly handed to us for examination and identification.

The specimen came from the cliff face at the south end of Christie's Beach, about half a mile north of Port Noarlunga. A detailed stratigraphical examination of this area is being made by one of us (Cotton), but the work is not yet finished. For this reason no definite conclusion is given here as to which particular Marine Stage the Tertiary specimen belongs. It can, however, be pointed out that the specimen came from the glauconitic layer about six feet in thickness, which is overlain by the Turritella clays. Beneath the glauconite layer is about ten feet of brown sand. All three layers are tilted gently upwards and rise in a northerly direction. The *"Turritella"* dominant in the clays is the species identified by Cotton and Woods 1935, as *Colpospira aldingae* Tate 1882, regarded as a Janjukian species. There are minor differences in the stratigraphy of the Aldinga section and that at Christie's Beach so that these details of stratigraphy are recorded. Larger specimens of this *Aturia* have been taken in this area, but the exact locality of the species here described is known so that it is deemed safer to select this specimen as holotype.

ATURIA CLARKEI ATTENUATA subsp. nov.

Description: Internal mould of a phragmocone, discoidal, involute. Whorls deeply depressed dorsally. Flanks of last whorl diverge at an angle of 30° and have a very shallow depressed zone near the ventrolateral shoulder. The centre of the lateral depression on the flanks lies on the umbilical side of the lateral lobe. Greatest diameter of specimen is 62·8 mm., width 32·0 mm., height of last preserved whorl 41·0 mm., height of that whorl above impressed zone 25·5 mm. The ratio of width to diameter of the phragmocone is 0·51, that of width to height of last whorl 0·78.

The siphuncle is of average size; its diameter at the adoral end of the specimen is 3·5 mm. It is encased in a solid tube formed of septal funnels which are in contact with the dorsal wall of the conch. The central portions of the septa are evenly, though not very strongly, concave. In the median cross-

section they swing backward in an even curve from the septal foramen. They are set well apart so that successive sutures never touch.

The external suture forms one broad lateral saddle on each flank. The umbilical limb of this saddle rises in an even curve from the umbilicus and reaches the point of culmination slightly before the middle of the flank is reached. It crosses the middle of the flank in a broad sweep and then curves down somewhat suddenly and passes into the steep, somewhat bulging dorsal limb of the lateral lobe. This lobe is long, acute and somewhat drawn out at the apex. Its ventral limb rises steeply, following approximately parallel to the curvature of the ventral side of the conch. It rises to little more than two-thirds of the height of the lateral saddle. The suture then curves abruptly ventrad and slightly backward and crosses the venter almost perfectly straight. The distance of the lateral lobe from the ventral side of the shell is about one-third the height of the whorl.

Comparisons: This form resembles *Aturia clarkei* in the following features:

1. Shape of lateral lobe and saddle of the suture.
2. Median section of septa which bend backward (adapicad) from the septal foramen and are not sickle-shaped as in *A. australis*.
3. Angle of divergence of flanks of whorls (30°).

It resembles *Aturia australis* mainly in the general proportions of the shell, particularly the comparatively narrowly rounded venter, and slight depression along a ventrolateral zone.

An important difference between the two species is absolute size, *A. clarkei* being the larger form, but no estimate of the original size of the present specimen can be made.

As far as can be told the specimen is intermediate between the two species, but resembles *A. clarkei* more closely in taxonomically important features connected with the structure of the septa and the shape of the sutures.

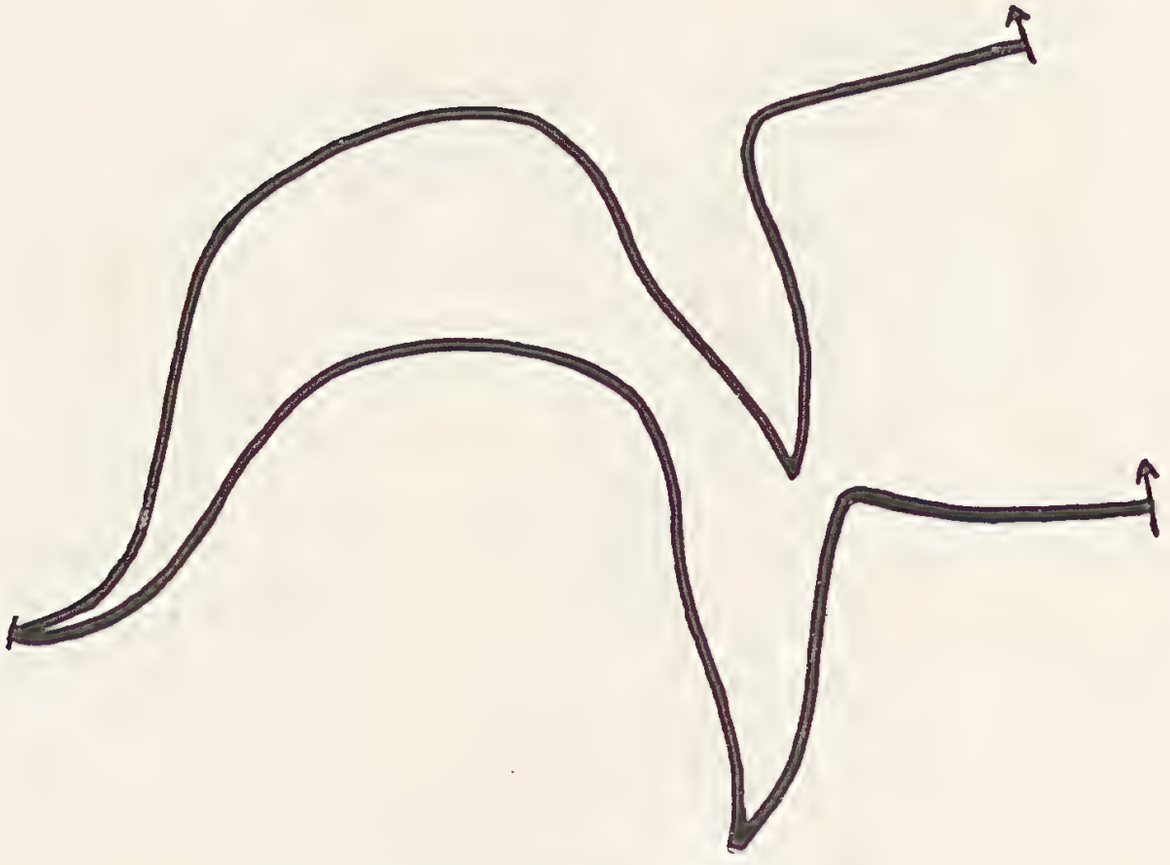
It seems possible that intergradation existed between the eastern species (*A. australis*) and the western species (*A. clarkei*). Typical *A. australis* extends westward as far as Mount Gambier in South Australia. Typical *A. clarkei* has not yet been found east of the Bremer River in Western Australia. Miocene sediments are widespread in the intervening area, where intermediate types such as the one here dscribed may be expected to exist.

Holotype, Reg. No. P.9027, S.A. Mus.

CONCLUSION.

On the available evidence it seems advisable to regard the Aldinga specimen as representative of a local variety of the Western Australian species.

Aturia clarkei attenuata (× 1·26).



External sutures of *Aturia clarkei attenuata*.

PALAEOLITHIC *KODJ* AXE OF THE ABORIGINES AND ITS DISTRIBUTION IN AUSTRALIA

RESULTS OF THE HARVARD-ADELAIDE UNIVERSITIES ANTHROPOLOGICAL EXPEDITION, 1938-1939

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Plate xxii and text-fig. 1–15.

INTRODUCTION.

The *Kodj* of the natives of Western Australia is a wooden handled stone implement of palaeolithic facies, used as an axe; sometimes as a hammer. It is composed of two stones mounted in a ball of gum with a stick as handle. Without doubt it is the most primitive type of hafted axe in use to-day.

Modes of *kodj* manufacture, uses, and details of the chipped discoidal stone implements which go into its making are of direct interest to students of living Stone Age folk and for the study of the archaeology of Upper Palaeolithic peoples.

During the Harvard-Adelaide Universities Anthropological Expedition, 1938–1939, information about *kodj* axes was obtained directly from aged members of the Wudjari tribe, near Borden, Western Australia. To these data have been added particulars obtained during 1936 by personal examinations of early collected *kodj* axes preserved in Museums overseas, including in Europe, those at Amsterdam, Berlin, Cambridge, Frankfurt-am-Main, Hamburg, Leiden, Leipzig, London, and Oxford; also, during visits in 1936, 1937 and 1945, in Museums at Cambridge, Mass., Chicago, Honolulu, New York, and Washington, D.C.

Gathering of these data was assisted by research grants from the South Australian Government, and from the Carnegie Corporation of New York. Grateful acknowledgment is made of this assistance. The co-operation of the Directors and Officers of the many Museums referred to in this paper was most helpful, and without their aid the study could not have been made. I am indebted also to J. B. Birdsell, my companion on the Harvard-Adelaide Anthropological Expedition, for the stimulus of mutual discussion of the problems solved and new ones aroused by the gathering of field information.

THE *KODJ* AXE OF WESTERN AUSTRALIA.

A *kodj,* as used at the time of early contact with Europeans, was a hafted, composite stone axe, of palaeolithic type, weighing about 450 grams. Typically, it was composed of two discoidally trimmed cutting blocks or flakes of stone each about 6–7 cm. in diameter and 3·0–3·5 cm. in thickness, set, to almost half their diameter, in opposite ends of a roughly spherical or elongate-flattened-oval ball of gum or resin about 9 cm. in diameter. It was provided with a handle, 2 cm. in diameter, and about 35 cm. in length, which was inserted into the ball of gum normal to the long axis and midway between the two flakes. The main axis of the handle and of the two cutting stones lay in the one plane. All three parts were independently set into place in the gum without touching each other, and, on the evidence of specimens examined, were supported in the gum only by the plastic material, without lashings. The two stones were so set, in apposition, that when the axe struck the work the "upper" or "original flake" surface of the stone in use lay on the side close to the work surface. The plastics used as the hafting medium were native pine gum (*Callitris*), porcupine grass gum (*Triodia*) and reportedly also blackboy gum (*Xanthorrhoea*). Fibres such as kangaroo fur and rabbit bandicoot fur were worked into the gum to strengthen it.

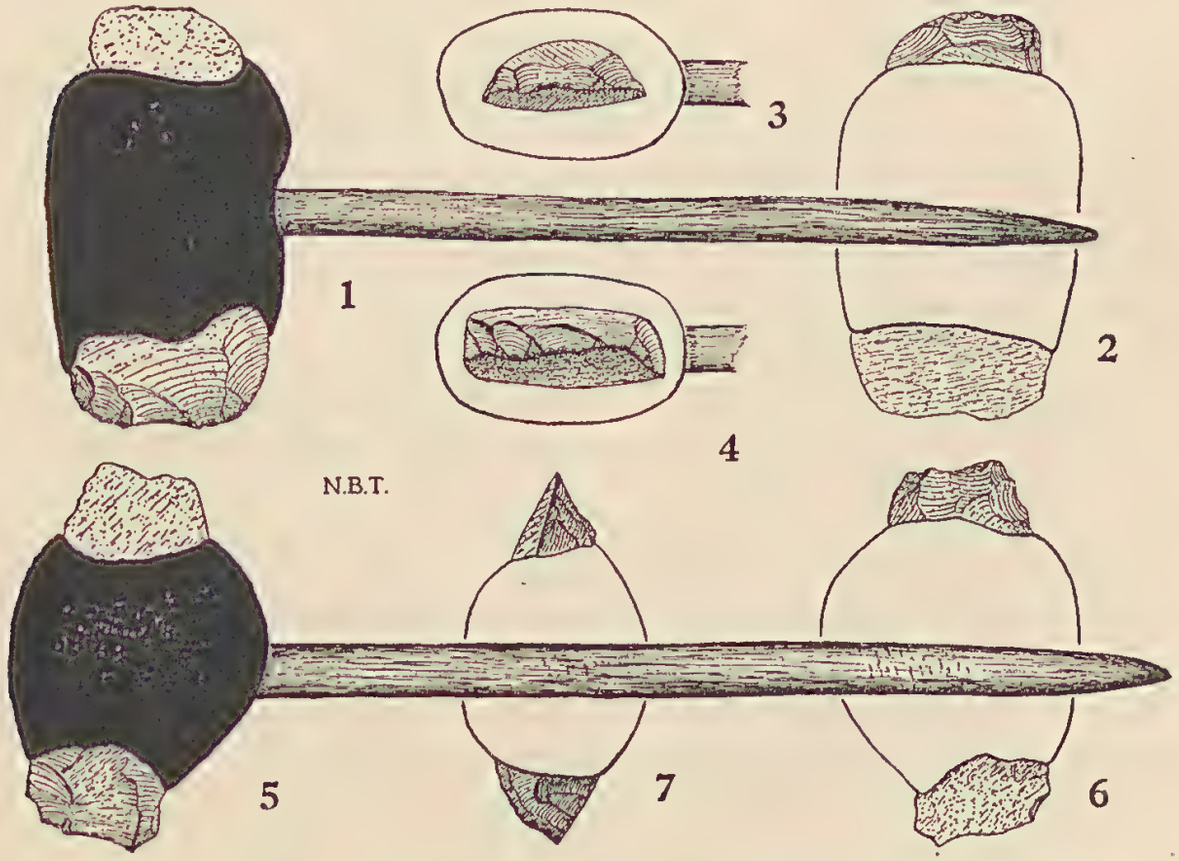
A variant of the typical *kodj* axe was the combined axe and hammer. In this the second cutting stone was replaced by a small hammer stone. So far as could be determined from Wudjari informants, no nomenclatorial differentiation was made between the axe *kodj* and the hammer-axe *kodj.*

In practice the one was readily convertible into the other merely by warming the gum of the implement over a small fire, removing the hammer stone, and replacing it with a second cutting flake. This operation could be carried out in a few minutes and the newly set hammer or axe was ready for use as soon as the gum cooled. The gum could be quickly chilled and set, either by placing it for a few moments in water, or in emergency, by urinating over it.

The example shown in fig. 1–4, closely conforms to the most developed form of *kodj* axe, and might well have been regarded as a type specimen. Unfortunately, however, it does not appear to have survived the bombing of Hamburg, during World War II.

Fig. 11, depicting a specimen from Bunbury, may be considered to illustrate therefore the most typical form of *kodj* excepting only that on it the stones are set as for use by a left-handed individual, of whom there appear to have been fewer than were right-handed persons. Of 37 *kodj* axes examined during this study six were ones made for left-handed use.

Distribution of the *kodj* type of axe at the time of first European contacts appears principally to have been confined to a triangular segment of south-Western Australia lying between Geraldton in the north, Bunbury and Albany in the south-west, and Israelite Bay in the east. This area was occupied by members of fourteen tribes. Specimens have not been reported outside this area excepting a solitary example collected among Bedengo tribespeople in the country north-west of Lake Tobin, and north of the Canning Stock Route, in the northern part of Western Australia.



Figs. 1–7. *Kodj* axes. Figs. 1–4. Axe for a right-handed man (356:06, Australia, in Museum für Völkerkunde, Hamburg). Figs. 5–7. *Kodj* from Western Australia (NS.9741 in Städtisches Völker Museum, Frankfurt-am-Main).

Surviving aged Wudjari tribesmen knew the *kodj,* as ['ko:tj], from personal experience. However, for many years past they had had no need for it, using in its place a metal tomahawk. Nevertheless, they were able to demonstrate methods of handling the *kodj,* to indicate some of the limits of its use, and give details of modes of manufacture.

According to Wudjari informants, the *kodj* axe was a general purpose cutting and hammering implement, employed, for example, in chopping hollow trees in order to secure small native animals, obtaining borer grubs and termites from trees and shrubs, and particularly in slashing "blackboys" or grass trees

(*Xanthorrhoea*) in search of grubs. It was also used when digging into the ground to break the soil. As a hammer it was useful for opening shellfish, cracking bones to extract the marrow, bruising seeds, and pounding ochres, clays, charcoal, etc., when preparing pigments for decorating the person and treasured possessions. When held at "short handle" (about half-way down the shaft) the pointed end of the handle could be driven into the thick bark of Eucalypts and other trees; with such aid the user often could secure a better climbing hold; at other times with the cutting blade he could prepare steps in the bark to assist his climb. Sometimes a separate climbing stick was used in conjunction with the *kodj* axe.

In cutting with this axe the handle was gripped well down on the shaft, and rather forceful blows with it were directed obliquely at the work face. It was not necessary to study the axe since it was not a delicate implement, but a tool for general use; the stones were held firmly in the gum, and their setting was unaffected even by the shock of heavy blows. The flake face of the stone implement was the one which passed close to the surface of work. This was necessary since otherwise the ridges and keels of the trimmed face might score into the work and interfere with the cutting effort as well as causing the axe stone to be jarred out of its setting. The cuts normally were struck in an oblique direction rather than across the grain of the wood. For a right-handed man, a favourite stance was such that the axe blows came obliquely from the right and fell on the work in the midline of the body. When so used the trimmed face of the working axe stone lay on the side of the axe directed obliquely upwards towards his left side. Because of the limitations of such an axe it is necessary that a left-handed man should have the discoidal cutting stones set the other way about in his axe, so that they face in the reverse direction and he, of necessity, strikes obliquely down from the left towards the midline of his body.

In cutting footholds in a tree the operator worked with his axe held over his head, and here again the blows tended to fall somewhat obliquely towards the left.

When cutting sections of wood, the piece, if of convenient size, would be turned continually end for end so that the cutting blows could always be made to fall in the one direction. As explained previously, this was necessary since the operator had to keep the trimmed face of the stone uppermost and directed away from the work face. In general, wood for weapons was split off from the living tree; much of the work other than the initial cuts being done with wedges. When obtaining such split off slabs from trees the man stood on one side of the tree (the right) to cut the upper notch, directing his cuts obliquely

downward. To make the lower cut he stood on the other side (the left) and then directed his blows upwards. Once the form of the weapon had been outlined on the tree, stick wedges were driven into the upper notch by blows from the hammer end of the axe.

In the later day manufacture of the axe itself, among the Wudjari, a suitable stone was found and after minor trimming, was mounted directly into the gum of the axe. Then, if its edge was not suitable for immediate use, it was trimmed by knapping with another stone. Ordinarily such trimming was only necessary when resharpening a blunt *kodj*, since when inserted the selected flake usually would have a sharp edge.

There were no surviving memories either of particular sources of good-quality or traded-stones, or of special methods of knapping the implements. Within their time it was usual for any available sharp-edged stones of suitable size to be brought to serve as *kodj* axe blades.

Enquiries were directed to many other natives of South-Western Australia. Usually their only recollection of the *kodj* axe was by name. The following words, applied to *kodj* axes, were obtained from such informants in the field. They are written according to the phonetic system in use when transcribing aboriginal words at the University of Adelaide:

Tribe	Axe	Locality.
Amangu	'kudja	Hill River to Greenough River.
Whadjuk	'kodj	Perth and vicinity.
Juat	'kodja	Hill River to New Norcia.
Wudjari	'ko:tj	Bremer Bay to Israelite Bay.
Kaneang	'kadjo	Harvey, Bridgetown and Broome Hill.
Wardandi	'palbu	Geographe Bay to Blackwood River.

EARLY AND LATE RECORDS OF THE *KODJ*.

The existence of the *kodj* axe has been known since the earliest contacts between whites and aborigines. An early reference is one by Peron and Freycinet who, during their voyage (1800–1804) obtained what seems to have been a *kodj* axe. They list it merely as "une hache de pierre". The figure (at plate 22 f.8 of the "Atlas") is not good. It possibly could be read to imply lashings attaching the stones to the handle, perhaps overlying a gum base; the hand grip is marked as if roughened or scored. Both stones seem to have their flaked surface on the same side. No specimen quite like his figure has been examined during the course of this study, and it is possible that the original sketch has become modified during re-drawing on the lithographic stone.

Mitchell (1949) is the latest writer to refer to the *kodj* type of axe. Under the names *"kodjo"* and *"kadjo"* (one or other of these apparently being a misprint), he describes and figures one, referring to it as follows:

"Kodjo is a form peculiar to Western Australia. . . . A mass of grass tree resin is attached to the extremity of a short stick and into this at opposite ends are fixed two pieces of stone. One has a crude cutting edge, the other is blunt and served as a hammer. These pieces of stone, if found detached from their setting, would certainly not be recognized as implements".

Mitchell's observations are based apparently on the examination of one or more of the transitional or degenerate specimens referred to below. His remarks may well illustrate the danger of any generalization on imperfect material. It can be asserted that true *kodj* stones, like any normal, used-adze stones or knives, etc., would be readily identifiable as humanly worked implements.

Despite the knowledge of the existence of the *kodj* axe and many passing references to it as an implement, few specimens have been minutely examined, described, and critically compared. Hence, up to the present, the *kodj* axe has remained, in Australia, one of the least well known of the hafted stone implements used by the aborigines. One of the reasons may be that after the beginning of European occupation the *kodj* axe rather quickly yielded place to a metal equivalent, while in the period of transition a degeneration in type took place. This change may have been due, in part, to breakdowns in supplies of suitable stone, received over old-time trade routes.

Specimens ascribed to post-European contact times usually lack good cutting stones. In recently made specimens the handles generally lack the polish which comes with continued use and very inferior specimens seem to have been made principally by aborigines for demonstration or to use in trade with white men who sought axes merely as curios. A common feature, particularly of those made only as "demonstration models," is the use of a thin, often crooked sapling as handle in place of the sturdy fire-hardened handle, polished by use, of the fully efficient *kodj*.

A rough census suggests that at least 37 specimens of the *kodj* axe are preserved in Museum collections. Of these, 21 specimens are early and original examples, and 16 are more modern and to some extent degenerate. Some of the best specimens are in European and American Museums; of 14 examples examined in Australian Museums, only two can be considered early specimens.

In the following paragraphs it is proposed to describe the appearance of the principal specimens of *kodj* axes available in various Museum collections, and to figure some of those appearing to throw light on the original form of this primitive type of axe.

In the descriptions certain general assumptions have been necessary regarding the probable shapes of such parts of the axe stones as are hidden within the gum mounts. In a few instances it was possible to explore the general shape of these parts with the aid of a warmed needle.

DESCRIPTIONS OF *KODJ* AXES PRESERVED IN MUSEUMS.

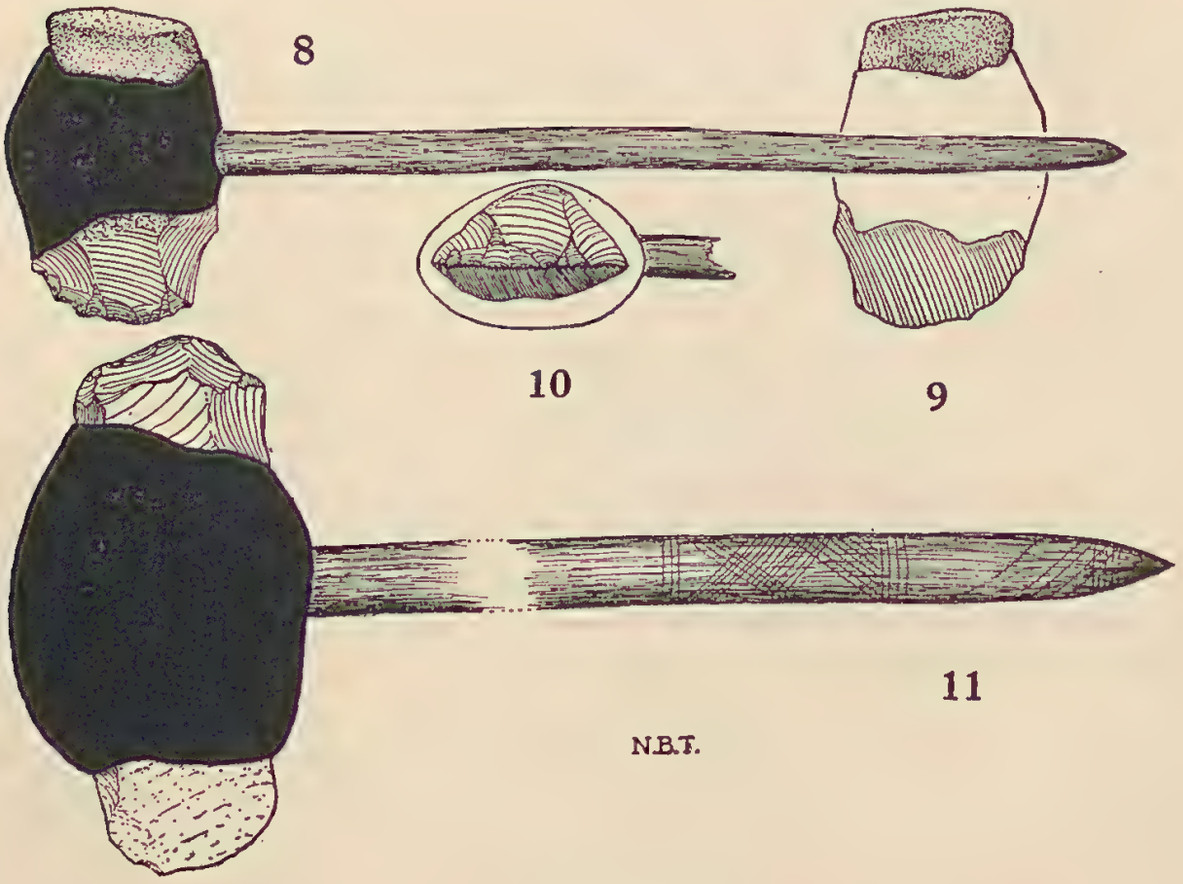
A *kodj* axe, labelled "Australia 356:06" in the collection of the Museum für Völkerkunde, at Hamburg, which unfortunately may have been destroyed during the bombings of World War II, is shown, from several aspects, as Fig. 1–4. This axe has an overall length of 31 cm. and is furnished with two discoidal, rather low-backed stone flakes, one somewhat larger than the other, set in a ball, probably of *Triodia* gum. This gum mount, during the passing of the years since it was fashioned, has been slightly distorted in shape and flattened on one face by a slow flow or slump of the hafting medium. The handle of this axe is smooth and well polished by use. Both stones are so set that in the normal working position the flake surface is to the right. The material of both *kodj* stones is a rather fine-grained, dark, and probably basic igneous, rock. The initial trimming of the stones appears to have been done prior to mounting in the axe; further secondary flaking, confined chiefly to the actual cutting edges, may have been done as a resharpening measure after use and at a time when the stones already were mounted in their present positions.

A second very early specimen in the same Museum is labelled "Swan River, New South Wales, 32.9:18". This label appears to date it to the earlier half of the 19th century when Swan River, Western Australia was still known as a remote part of the colony of New South Wales. The specimen, not figured here, is 34 cm. in overall length, with two discoidally trimmed axe stones set in a rather spherical ball of gum, 7 cm. in diameter. Despite its apparent age this gum haft is firm, showing few signs either of deformation or distortion due to flow. The handle gives evidence of polish and wear in use. The axe stones, not quite so well trimmed as in the axe figured, are made from a similar type of dark rock.

Fig. 5–7 show several aspects of a *kodj* axe labelled "N.S. 9741, West Australia" in the Städtisches Völker Museum, Frankfurt-am-Main. In overall length it is 38 cm. with a height of 11·5 cm. It has two discoidal stones, each 4·2 cm. in diameter and respectively 2·0 and 3·0 cm. in height, measured in a direction normal to the plane of the "flake" surfaces of the original tabular pieces of basalt from which they were made. The handle is 1·5 cm. in diameter, its extremity tapered to a sharp hardened point; the surface is worn

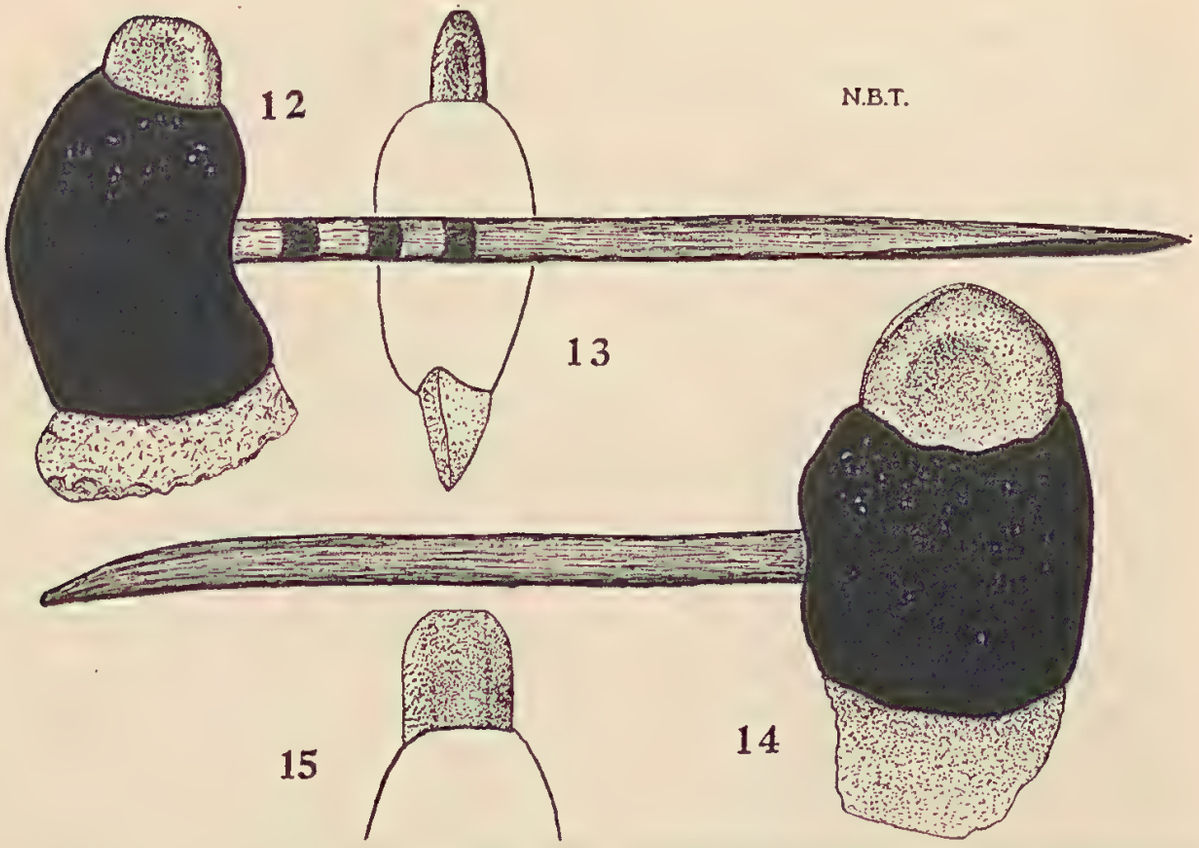
smooth with use. At two places on the handle there are traces of series of irregular incisions.

Both stones have been fashioned from tabular pieces of black basalt, primarily trimmed by taking off large irregular flakes, and only in the course of resharpening have been secondarily trimmed.



Figs. 8–11. *Kodj* axe and hammer axe. Figs. 8–10. *Kodj* hammer axe (52208 in Peabody Museum, Cambridge, Mass.). Fig. 11. *Kodj* axe for a left-handed man from Bunbury (E 39 in Western Australian Museum).

Fig. 8–10 serve to illustrate a *kodj* (No. 52208), in the Peabody Museum at Cambridge, Massachusetts. This example is a composite hammer and axe and the cutting implement is a discoidal block of coarse, dark, basic igneous rock, set in a relatively small ball of gum. At a late stage in its history as an axe, the near margin of this stone was broken away, thus deforming its originally greater discoidal symmetry and removing some of the secondary trimming. The end opposite is adapted for use as a hammer; on this extremity it has a battered tabular piece of rock of somewhat similar composition to that of the cutting flake. This tabular stone bears indications of much use as a hammer as well as some evidence of prior use as a cutting blade.



Figs. 12–15. Hammer axes. Figs. 12–13. *Kodj* made from quartz pebbles. (588/2 Western Australia, in Rijks Ethnographisch Museum, Leiden). Figs. 14–15. Axe with quartzite pebble hammer head (No. 59356 in United States National Museum, Washington, D.C.), a reverse view of this axe appears in Plate xxii, top figure.

Fig. 11 depicts a specimen in the Western Australian Museum, labelled "Bunbury, W.A. E39, collected by Colonel Phillips". The donor of the specimen was Commissioner of Police in Perth when the Museum was first established in that city and the axe was among the earliest material registered in the collection, it previously having been in a collection preserved by the Police Department. Probably this is the best specimen preserved in any Australian Museum. Its weight is 680 grams and it is 39 cm. in overall length, with the visible part of the handle accounting for 30 cm. It has two discoidal cutting stones of typical form, respectively 5·0 and 6·0 cm. in diameter, both trimmed from tabular blocks. This axe is unusual in that both the stones have been set in gum so that in the position of use the flake surface of the working stone faces the left; from this it may be inferred that the maker and user was a left-handed man. The handle is particularly stout, decorated with finely incised lines, and has a sharp almost cutting edge on the wood near the fire-hardened and pointed tip.

Three other examples are present in the Western Australian Museum; they are poorer, with relatively crude stones and inferior handles. E.637 is from Bunbury, W.A., received in 1901 from G. W. Teede; it weighs 482 grams.

No. 4193, obtained from T. R. Ward in 1911, without locality or other data, weighs 397 grams, and No. 9919, secured from Mr. Rogers of Katanning, and said to have come from that district, weighs only 283 grams.

Fig. 12–13 represent two views of a specimen, No. 588/2 in the Rijks Ethnographisch Museum at Leiden, labelled as coming from Western Australia. It is one referred to by Schmeltz (1904), in a catalogue of the Clement collection, although, as indicated in a footnote (p. 21), the specimen did not belong to Clement's collection, but was an older one in the abovementioned Museum. The cutting tool is made from a wedge-shaped flake or slice from a rounded and very smooth quartz pebble. The flake surface of this slice bears signs of retrimming after use. The opposite end bears a smooth flat oval quartz pebble whose ends and four exposed lateral faces are much battered; viewed from above the pebble appears roughly hexagonal in form, while the gum is smooth and very black. The handle is 1·3 cm. in diameter, smooth, and tapers to a rather sharp point. The portion of the handle near the extremity is flattened on one side and evidently was once the tip of a wooden spear; in a spear it is against such a flattened face that the single wooden barb is lashed on, with sinews. Three bands of black gum smeared on the handle appear to be a form of decoration; such decorative gum bands are present also on spears from Western Australia. The haft shows signs of extensive handling. The total length of the axe is 35 cm., and the distance between cutting edge of the axe and the surface of the hammer is 14 cm. Hammer stone diameters, when viewed from above, are 3·5 cm. and 1·5 cm.; the length of the portion inserted in the gum was not ascertained.

Fig. 14–15 give two views of a *kodj* axe in the United States National Museum at Washington, D.C., and labelled "59356, Australia, Willard Nye". A third view of this implement is given in Plate xxii, A, where the trimmed face of the axe stone is shown. The specimen is suitable for use by a right-handed individual. The upper stone in this axe is a hammer, formed from a piece of an oval, rather flat-sided quartzite pebble, much battered and worn. The gum of the haft is brittle and cracked with age, but preserves all the essential features. The handle itself is relatively short, with its extremity trimmed rather abruptly downwards to a blunt point; it is highly polished by use.

In an example preserved in the collection of the American Museum of Natural History in New York $\left(\frac{80{\cdot}0}{{\cdot}3315}\right)$ there is a good discoidal cutting stone fashioned on a block, and combined with a much battered hammer stone. The handle has been used either for digging or as a climbing stick; although much polished by use, the tip of the handle is still sharp.

There are four good examples of *kodj* axes in the Pitt Rivers Museum at Oxford. One has a very fine discoidal stone similar to that in fig. 1. Opposed to it is a hammer stone much as in fig. 12; this specimen is labelled "West Australia 1910 (Webster)". A second, probably very early specimen, with handle indicating much use, is labelled "W. Australia, from Sir A. Evans 1928". It has a cutting stone which has been much reworked. The fourth is a rather crude specimen, possessing two rough flakes, set in a gum-mounted handle, labelled as from the "Pidungu tribe, 60 miles from Derby, N.W. Australia". This is the northernmost record of the *kodj* type of axe, as Pidungu is to be identified with the [Bedengo] tribe, whose territory is an area, still rather poorly defined, situated south of the Fitzroy River and north-west of the Canning Stock Route.(1) In addition to these four axes in the Pitt River's Museum there are two other indifferent examples with crude "demonstration" stones and handles showing few signs of use.

A specimen (Au. 1180) in the Grassi Museum at Leipzig is typical of late, probably functionally degenerate specimens. It is 30 cm. in total length and 11 cm. between the cutting edges of the opposed stones; as in fig. 11 the stones are set for use by a left-handed person. The handle is a crooked stick not more than 0·8 cm. in diameter with its extremity sharpened to a point.

The Museum für Völkerkunde, Berlin, possesses a specimen (VI 4450) labelled only as from "Australia". This has two stones made from flakes of granite; one stone is sharp, for cutting, and the other blunt, as for hammering. The handle is thin, worked and ornamented with three rings of gum which are placed, not near the head as in fig. 12, but low down on the shaft where the axe normally would be held; the tip of the handle is rather indifferently sharpened. This appears to be a late, demonstration example with handle made from portion of a spear. This axe is similar to one of the specimens in the South Australian Museum collection.

There are three specimens labelled "W. Australia" in the South Australian Museum collection. One (A.15244) is an inferior demonstration example with a thin unserviceable handle and may be dismissed from this study. A second (A.15245) gives evidence of wear, the pointed end of its handle being polished by use. This axe has an overall length of 35 cm. and measures 15 cm. between the two cutting edges. Each stone is a discoidal flake of a coarse textured granite containing large felspars; evidently both stones were intended for use as cutting implements. One flake is 5·0 cm. in diameter and projects 3·0–3·5 cm. from the gum haft. The second is 5·5 cm. in diameter and projects

(1) In a map of the distribution of tribes (Tindale, 1940), the tribal name Bedengo is printed rather too far south on the map, and, as stated in the text (p. 201) probably would be better placed well north of Lake Tobin.

2·0–2·5 cm. from the gum. Although crude, each flake has been trimmed carefully on a tabular piece or a casual flake and the flakes, set opposite are so placed as to be suitable for use by a right-handed user. The weight of the axe is 295 grams. A third and left-handed specimen, found on an abandoned camp, with the two stones still held in a distorted mass of gum, lacks its handle. The trace of the space occupied by the handle is still evident in the gum.

Four specimens are preserved in the Australian Museum, Sydney; the three examined were of late origin and present little of particular interest; one example (E.5983) is left-handed.

Two good examples are housed in the Bishop Museum at Honolulu; one, No. 1922, has two stones of excellent trim, 4·5 and 5·0 cm. in diameter, set for use by a left-handed man; the other, not registered, is right-handed. In this second example, Plate xxii, B–C, the gum has slumped with age revealing the form of the well shaped, much retrimmed stones; one stone is 7·0 cm. and the other 6·0 cm. in diameter.

In the Museum of Archaeology and Ethnology, Cambridge, England, is a late example of a *kodj* axe with granite flake blades, "1902–169, Australia, ? R. E. Froude."

In the British Museum there are eight examples of which one (4769, Christy Coll.) is left-handed and the rest right-handed. The best example is one of the earliest, received in 1839, from the Swan River (39.6.20). The chopping blade is made from a tabular piece of igneous rock which has a few shallow casual flake facets on the working face; all the secondary trimming is on the normally flaked side. It has a similar piece of igneous rock mounted at the opposite extremity. This seems to have been intended as a second cutting edge but is much battered by later use as a hammer. Six of the others in the British Museum are hammer-axes; they have typical, usually well-formed *kodj* stones, in most instances they show much retrimming. In one example (9498, dated 1875) the stones are crude and made from a coarse granitic rock. In two examples (W.A. 93.1858 and W.A. 267) the handles are shorter than usual, being only about one-half the length of a normal axe handle in 267. In all specimens, however, the handles are equally robust and are polished by use. The eighth example, ×1614, from Murray River [Western Australia], differs from the others in that the handle is squarely cut off, while the blades, which are of flint, are smaller than usual. This curious example may have been used by a child; it is not certain that originally the handle was truncated as it is now.

From details given in the above summary of available specimens and the statements of Wudjari aborigines it has been possible to draw up the generalized picture of a typical *kodj* axe cited earlier in this paper.

A few other *kodj* axes have been reported. Oldman (1905) lists two from Western Australia; his 8135 had a "syenite head embedded in black gum, pointed handle; length 11 inches (28 cm.); width across 5 inches (12·5 cm.), and his 4636, is similar "with length 15½ inches (39·5 cm.) and across head 5 inches (12·5 cm.)."

Webster (1899) also listed two examples from Western Australia. Of these, one (×444) differs from most of those described above in having a handle with the end squarely truncated. It is referred to as having a "stone head fastened with blackboy gum, head 4½ inches (11·5 cm.), full length 12¾ inches (32·5 cm.).

ARCHAEOLOGICAL DISTRIBUTION OF THE *KODJ* AXE.

At the time of first European settlement, use of the *kodj* axe appears to have been confined to portions of Western Australia; the only evidence for wider distribution is of an archaeological kind.

Stone implements of types similar to those used in *kodj* axes are found as relics in both Western and South Australia, and generally in Australia. Small hammer stones such as form the hammer end of the *kodj* also are found in many places.

As an archaeological type the *kodj* axe stone was probably first described and figured by Tindale and Maegraith (1931) and subsequently was given by Tindale (1937) the name of *"karta."* When this paper was submitted for publication there had been no recognition of possible relationships between *karta* stones and *kodj* axe stones. The *karta* implements were originally described from Kangaroo Island, where they constitute one element of an extinct stone industry called the Kartan Culture. With present knowledge it seems probable that if stones such as are depicted, for example, in Fig. 12, were found as archaeological relics, they would be classified as ordinary *karta.*

If the former range of *kodj* axes is in any way correctly indicated by finds of *karta* stones, then this type of axe was once widely spread in Australia. Details of the distribution of *karta* may well be the subject of a separate survey when full data for their distribution have been brought together.

Miniature oval and circular hammer stones such as form the hammer end of *kodj* hammer axes are commonly found in many, but probably not in all places, where archaeological *karta* have been reported. Howchin (1934), for example, figures typical examples of these miniature hammer stones from Adelaide under the term "fabricators".

While it should not be assumed rashly that all small hammer stones were used in *kodj* axes, examination of known *kodj* hammer stones suggests that

they should be readily recognizable, because on them there are strongly abraded facets in close juxtaposition to areas which have been protected underneath the gum of the haft. The concentration of wear in certain definite parts of the stone is marked; other portions lack all but the slightest traces of abrasion. Often when a *kodj* hammer stone has been turned on its axis several times and re-hafted many times the results of differential abrasion are very evident.

In the past theorists have suggested uses for small hammer stones. Some have contended that they are ones which were held delicately in the fingers for fine work in retouching and knapping flint. However often it has been difficult to correlate the presence of well-battered terminal facets with the smooth and relatively unmarked outer margins, and to reconcile these with the light weights of the stones. These difficulties tend to vanish when such stones are seen as components of composite implements whose overall weights and dimensions approximate to those of any normal hafted hammer (weight 400–600 grams).

DISCUSSION.

In terms of cultural stratification the *kodj* axe seems to represent the most primitive type of hafted Australian axe. It has survived in Western Australia in an area isolated by deserts from the country to the north and east, where more advanced types of stone axes are used. The people of the Western Desert tribes possess no axe; their environment, from its general lack of trees, is such as not to encourage the carrying of any form of axe. Hence it seems evident there was an effective barrier against the spread of more advanced types of hafted axes from the north and east. Viewing Australia as a whole the *kodj* axe is stratigraphically overlaid by several other axe strata, including the edge-ground pebble axes, edge-ground flake axes, and hammer-dressed ground-edge axes; the two last-named may represent respectively Epipalaeolithic and early Neolithic stages in axe development. Fully Neolithic types did not reach Australia, although they are abundantly present in New Guinea and the islands to the north of Australia. The existence of the *kodj* may help to account for the rather unheralded appearance of edge ground axes, since re-examinations of Upper Palaeolithic implement assemblages with the gum hafted *kodj* in mind may yield new evidence for the existence of gum-hafted implements as early as Upper Mousterian times.

Based on an early published figure by Angas (1847) it was formerly thought, though not explicitly stated in print, that a type of *kodj* axe might have been used in the vicinity of Adelaide in South Australia. Angas's figure seemed to show two separate stones of an unequal size, set in gum like a *kodj*, and

embraced by a bent withy, which formed a handle and was bound around with string. However, Angas's picture had been redrawn for publication by a lithographer and was not very clear. When reference was made to the original Angas painting, preserved in the South Australian Museum collection, the double stone theory seemingly could not be confirmed. Plate xxii, fig. D, is a photographic reproduction of the original watercolour. It can be interpreted as showing that the example which Angas examined was a much worn edge-ground flake axe with reduced butt. This axe blade seems to be similar to ones formerly traded southwards along the "Red Ochre Trade Route," which runs from Cloncurry in Queensland via the Diamantina River to Parachilna in the Flinders Ranges. Angas's description of this Adelaide axe does not seem very clear, and he uses Ramindjeri names, there being no known Kaurna ones. He states: "*Mokani* or *ngarunde*—a native stone tomahawk or axe fastened between two pieces of wood; this is very similar to the *mogo* or stone axe, of New South Wales." The description appears to rule out any "two stone" theory. Meyer (1843) upon whom Angas often appears to lean for his Ramindjeri native vocabulary, gives:

"'*mo:kani* s. black stone, something like a hatchet, the head fastened between two sticks which are bound together and form a handle. There is a sharp edge, which is used to charm men, while the other end of the stone is blunt and rough, and is used to charm women."

The word ['mo:kani] also has other meanings in the same district. As a substantive it signifies "stranger", as an adjective "strange" or "wild".

Angas's term *ngarunde* is the ['ŋarinde] of the Ramindjeri, which is not mentioned by Meyer. In the South-East of South Australia Potaruwutj tribespeople use a similar word ['ŋarin] derived from ['ŋarari] "wood which has been trimmed" and ['inde] or ['ŋinde] agent. The Ramindjeri term evidently is similarly derived; very likely the word has been borrowed from the eastern people.

There remains a slight possibility that Angas did figure a *kodj*-like axe, but that when he composed the letterpress for his book he followed Meyer in describing it in terms of the edge-ground stone axe of the south-eastern parts of Australia. Final proof is not available since no hafted specimens of a Kaurna tribe axe are known to have been preserved. The only surviving relic from the vicinity of Adelaide is a single bent withy handle. This, virtually identical with the one shown in Angas's figure, has the axe-head, gum, and lashings wanting. The fact that it is a withy to wrap around a head seems to point to a solid stone head rather than a *kodj*-like composite.

On the basis of this single specimen Angas and Meyer may be assumed to be in error in their descriptions since they state that the handle is composed of two sticks. However, the head end of a withy wrapped around a stone axe normally would be concealed by gum and by lashings; the probable mistakes in observation are therefore not unlikely ones.

Meyer's "black stone" hatchet fits so well with present knowledge as to leave little doubt it is the description of an example of the dark, greenish-black, edge-ground diorite or basalt axe from Western Victoria, traded west to Encounter Bay. Here it is at the extreme western periphery of its range, and is known as ['mo:kani], a rare, strange object, used principally as a charm. This is not surprising since it may be suspected that specimens which had passed by way of use and trade so far from their place of manufacture, would be ones already so worn down by constant resharpening as to be of indifferent service as hatchets. The borrowed word ['ŋarinde] also points in the same direction for the derivation of axes in Central South Australia.

In line with this are indications from many years of archaeological gleaning. On the one hand only a single specimen of an edge-ground axe (A.15427 in S.A.M.) has been found on the Adelaide plains, and this at Marion, where many Encounter Bay natives camped in the first days of white settlement, while fewer than half-a-dozen are known to have been picked up west of the Murray River or south of the Flinders Ranges. On the other hand, many hundreds, if not thousands, have been discovered north and east of these limits in the main areas of distribution of edge-ground axes. In the Murray Valley where excavation data are available, they are an accompaniment only of the Murundian Industry, the latest cultural horizon (Hale and Tindale (1930)).

In regard to sources of supply of *kodj* stones a letter, dated 3 July 1939, from Mr. H. W. Baker, of the Katanning Branch of the Western Australian Historical Society, has just been drawn to my attention. It indicates that one source of *kodj* axe stones may have been near Kojonup. Mr. Baker writes:

"Efforts have been made to trace the origin of the name of the town of Kojonup. I made enquiries from a few old settlers of this district. . . . Mr. W. D. Grover informed me that this name was a contraction of the native term 'Koitch-an-up', meaning 'a place where axes are obtained.' The axe referred to, of course, is not the 'Kelly' with which whites are familiar, but a stone axe with wooden handle used by the aborigines for cutting notches in trees and for kindred tasks."

SUMMARY.

The *kodj*, a type of palaeolithic hafted stone axe and hammer, is studied and its modes of use, manufacture, and distribution in Western Australia described. Archaeological *kodj* stones have been found in other parts of Australia. The stratigraphical position of the *kodj* as the most primitive of hafted axes, is discussed and references are made to the finding of axes of more advanced types in South Australia.

REFERENCES CITED.

Angas, G. F. (1847) : South Australia illustrated, London.

Hale, H. M. and Tindale, N. B. (1930) : *Rec. S. Aust. Mus.*, 4, p. 206.

Howchin, W. (1934) : Stone implements of the Adelaide tribe of aborigines, Adelaide, p. 71 and fig. 123–125.

Meyer, H. A. E. (1843) : Vocabulary of the language spoken by the aborigines of the Southern and Eastern portions of the settled districts of South Australia, Adelaide.

Mitchell, S. R. (1949) : Stone Age Craftsmen, Melbourne, p. 78, and pl. 4, fig. 6.

Oldman, W. O. (1905) : Catalogue of ethnographical specimens, London, 29, Nos. 57–58.

Peron, F. and Desaulses de Freycinet, L. C. (1807?) : Voyage de découvertes aux Terres Australes, Atlas, Paris. pl. 22, fig. 8.

Schmeltz, J. D. E., *in* Clement, E. (1904) : *Internationales Archiv für Ethnographie*, Leiden. 16, p. 21, pl. 3, fig. 13.

Tindale, N. B. and Maegraith, B. G. (1931) : *Rec. S. Aust. Mus.*, 4, pp. 275–289.

Tindale, N. B. (1937) : *Rec. S. Aust. Mus*, 6, pp. 39–60.

Tindale, N. B. (1940) : *Trans. Roy. Soc., S. Aust.*, 64, p. 201.

Webster, W. D. (1899) : Illustrated catalogue of ethnographical specimens, Oxford, No. 20, fig. 121.

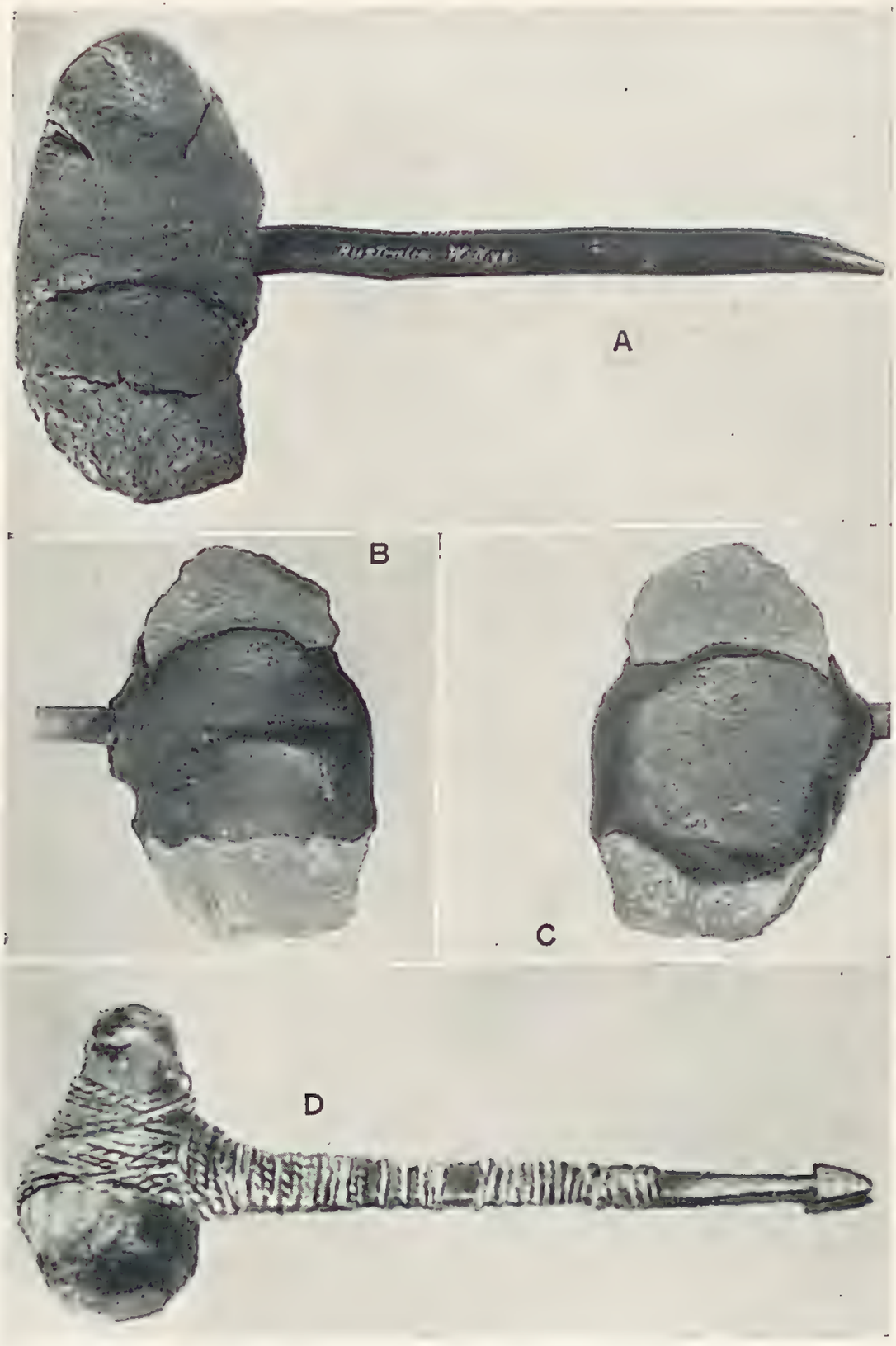
EXPLANATION OF PLATE.

Plate xxii.

A. *Kodj* hammer axe (No. 59356 in United States National Museum, Washington, D.C.).

B–C. Two aspects of a *kodj* axe (Bernice Pauahi Bishop Museum, Honolulu; not numbered).

D. Photograph of original G. F. Angas watercolour depicting *mokani* stone axe from Adelaide.


A
B
C
D

The SCINCID GENERA *EGERNIA* and *TILIQUA* (LACERTILIA)

By FRANCIS J. MITCHELL, South Australian Museum.

Plate xxiii and text fig. 1–10.

This paper correlates our limited knowledge of the genera *Egernia* and *Tiliqua* and provides a working basis for further study. Approximately 475 specimens are studied; and of the 30 species and subspecies recognized, 28 have been examined. It will be necessary to collect and report on further material before satisfactory conclusions concerning distributions and inter-relationships of these lizards can be determined.

Except where otherwise indicated by the letters W.A.M. (Western Australian Museum) or Qld. Mus. (Queensland Museum) the registration numbers given are those of the South Australian Museum.

Mr. G. Mack, Director of the Queensland Museum and Mr. L. Glauert, Curator of the Western Australian Museum have kindly made available specimens in their charge, while Mr. J. R. Kinghorn of the Australian Museum, Sydney, has substantiated several details from material in that institution.

A REVISED CONCEPTION OF THE GENERA *EGERNIA* AND *TILIQUA*.

Boulenger (1887, p. 142) distinguished *Trachysaurus* Gray from its nearest ally, *Tiliqua* Gray, on several small variable scale details, such as the usual presence of an azygous occipital and the division of some of the subdigital lamellae, together with the abbreviated stump-like tail. Other than this latter character, which would appear to be a specialization rather than a basic phylogenetic character, there are no features in the single species which could be considered of value for generic separation. The general scalation, dentition and osteology are identical with those typifying *Tiliqua*. Reference of the stump-tailed *rugosa* to *Tiliqua* is paralleled by the admission of *stokesii* and *depressa* to *Egernia*. All three of these species show a caudal specialization but no basic differences from typical long-tailed members of their respective genera. The caudal vertebrae of *rugosa* taper uniformly to a point and are not dilated in any way to support the depressed tail.

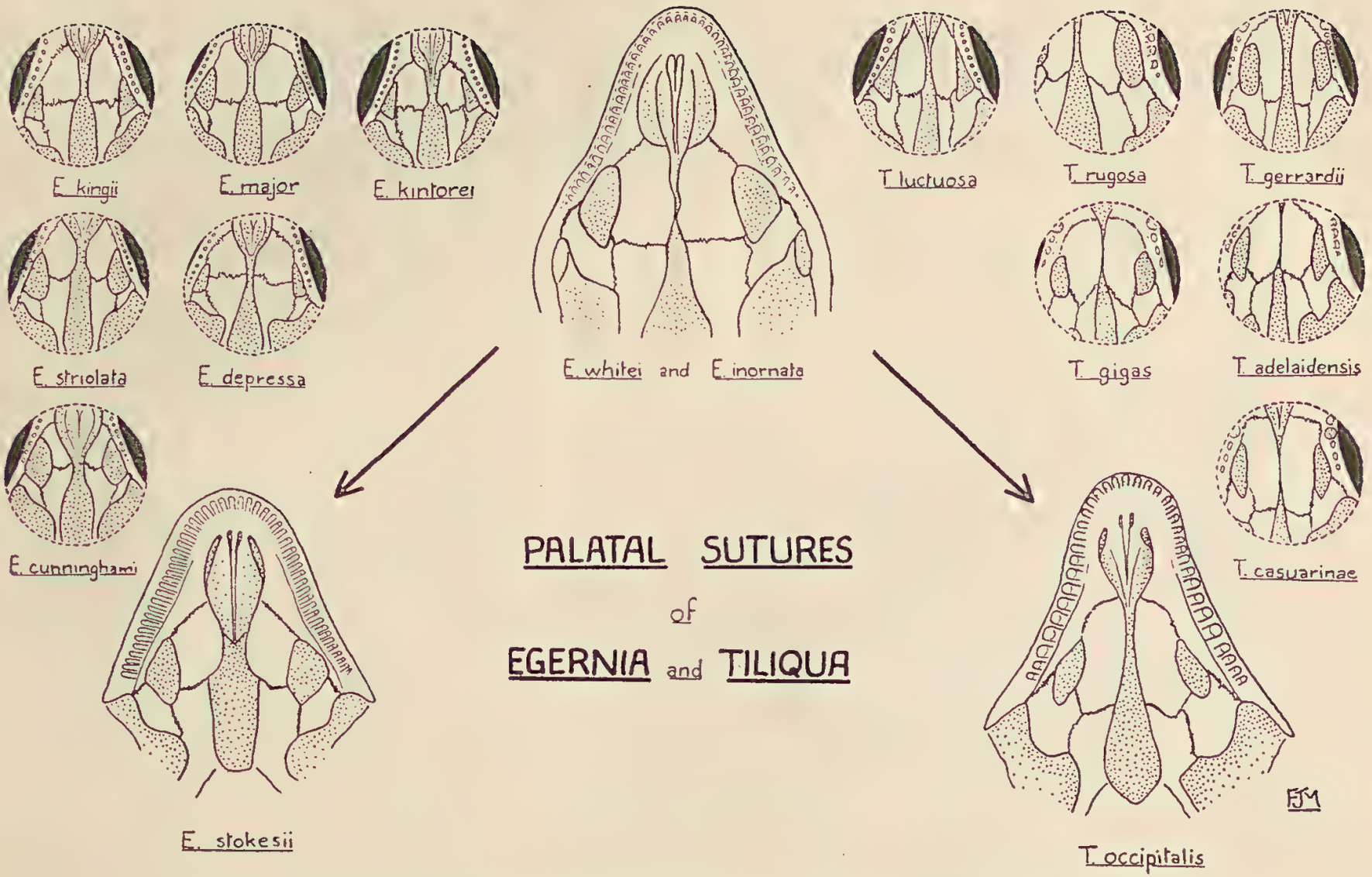


Fig. 1. A series of drawings illustrating the relative positions of the palatal sutures in the two genera and demonstrating the tendency toward a mean condition.

An examination of a single juvenile specimen of *Tiliqua scincoides gigas* (Schneid.) from Tanpora Island, near the extreme south-eastern tip of New Guinea, and several other members of *Tiliqua* has revealed a link between this genus and *Hemisphaeriodon* Peters. It has shown that the enormous spheroidal crushing teeth, stated to be characteristic of the latter genus, are not restricted to it, but are represented to varying degrees in several species of *Tiliqua,* being most prominent in subadult specimens. (Compare the enlarged teeth shown in plate 1, fig. a and b).

As but a single specimen was available to the writer, Mr. J. R. Kinghorn of the Australian Museum, Sydney, kindly examined this character in some of the specimens in his charge, and he has stated that although his specimens possessed enlarged teeth, none showed enlargement to the extent generally evident in *Hemisphaeriodon.* An examination of the dental characters of other members of the genus has revealed one other species, *T. casuarinae* (Dum. and Bibr.) with similar enlargement. (See plate 1, fig. c). This is a probable reason for the placing of the synonym *Hemisphaeriodon tasmanicum* Lucas and Frost in that genus. Many juvenile specimens of *T.s. scincoides* (Shaw) also possess one, sometimes two markedly enlarged teeth in each jaw.

The above data raise grave doubts regarding the value of this dental enlargement as a generic character, and as the scalation and osteology of *gerrardii* are typical of *Tiliqua* there would seem to be little ground for the retention of the generic name *Hemisphaeriodon.*

At the conclusion of his description of *Tiliqua longicauda* (= *gerrardii*), De Vis (1887, p. 816) refers to his two principal distinguishing characters, viz. the absence of a post-narial groove and the length of the tail, as "sufficiently distinctive—indeed generically abnormal". Although abnormal at that time, both of these features were ascribed to *Tiliqua* by M. A. Smith (1937) when he transferred four long-tailed species of *Omolepida* to *Tiliqua.* Only two of these are herein recognized. The post-narial groove is absent in *casaurinae* and only faintly present in *branchiale.* Peters' *luctuosa,* which is transferred from *Egernia* to *Tiliqua,* also lacks a distinct post-narial groove and has a tail of similar length and form to that of *gerrardii.* The action of Smith (*op. cit.*) has been confirmed by an examination of the palatal sutures and dentition of the transferred species.

The above reasons, together with the fact that the addition of *rugosa* and *gerrardii* to *Tiliqua* will not make that genus unwieldy, are considered sufficient grounds for regarding *Hemisphaeriodon* and *Trachysaurus* as synonymous with it.

Egernia and *Tiliqua* as now recognized can be separated readily as follows:

1. Palatine bones not sutured on the midline of the palate; pterygoid bones widely separated.

   (a) Pterygoid-transpalatine suture arising from a point on the orbital vacuity; teeth with acute, compressed crowns, slightly recurved .. .. *Egernia*

   (b) Pterygoid-transpalatine suture not contacting the orbital vacuity, but arising from a point on the palatine suture; teeth tending to be spheroidal or obtusely conical, not recurved .. .. *Tiliqua*

Fig. 1 shows that although extremes in each genus are readily distinguishable there is a marked convergent tendency in osteological, and to a lesser extent in dermal characters. This suggests that the two genera have separated relatively recently from a common stock and have developed along two monophyletic lines, indicated by the relative position of the pterygoid-transpalatine suture. Accepting this view, the most archaic species would appear to be the *Egernia whitei—inornata—kintorei* group. The palatal sutures of all species and races belonging to this group are almost intermediate between the two generic extremes, the pterygoid-transpalatine suture generally meeting the palatine suture very close to or on the orbital vacuity (see fig. 1).

Although the above hypothesis should be regarded as speculative at present because of the limited data on which it is based, it satisfies the line of thought which seems most useful.

The point now arises as to whether or not the above generic definitions should have been made absolute by the inclusion of *kintorei, whitei* and *inornata* in *Tiliqua*. If the definitions are accepted as absolute, the genotype of *Egernia*, (*whitei*) would be referable to *Tiliqua*, necessitating the designation of a new generic name for the remainder of the *"Egernia"* species.

In view, however, of the uniform gradation from the extreme *Egernia* to the extreme *Tiliqua* type condition, a third generic arrangement could be proposed. All species could be placed under *Tiliqua* with three subgeneric divisions, *Tiliqua, Egernia* and a new division.

For the sake of simplicity, the desirability of retaining well establshed names, and the doubtful value of proposing additional ones, the *whitei, inornata, kintorei* group are herein regarded as extreme members of *Egernia*, notwithstanding the fact that there are reasons to support each of the other alternatives.

EGERNIA Gray (1839, p. 288).

Palatine and pterygoid bones separated on the mid-line of the palate; lateral teeth generally more than 35 in number with acute, incipiently tricuspid crowns, slightly recurved; pterygoids toothless or with slight rugosities. Eyelids well developed, scaly; nostril pierced in the nasal, with or without a curved groove behind. Supranasals absent, prefrontals well developed; frontoparietals and inter-parietal distinct, the latter completely separating the parietals. Body elongate; limbs short, pentadactyle; digits cylindrical or slightly compressed with inferior transverse lamellae.

KEY TO SPECIES AND SUBSPECIES OF *EGERNIA*.

Werner (1910, p. 472) constructed a large and cumbersome synoptic key to cover sixteen of the species and subspecies of this genus. Apart from difficulties in operating his key, its numerous inconsistencies, and its inaccessibility to many workers warrant the following dichotomic key, compiled from material examined during the preparation of this paper together with the type description of *frerei* Gunth., the only recognized species not available for examination.

1. Tail subcylindrical, almost as long as or longer than the head and body 3
2. Tail depressed, spinous, much shorter than the head and body .. 29
3. Dorsal and caudal scales smooth or faintly striated 5
4. Dorsal and caudal scales uni- or multi-carinate 17
5. Post- and/or sub-narial grooves present[1] 7
6. Post- and sub-narial grooves absent 15
7. A median row of laterally expanded upper caudals 9
8. Upper caudal scales uniform 11
9. Expanded upper caudals present on anterior half of tail *striolata striolata*
10. Expanded upper caudals on posterior half only .. .. *striolata nitida*
11. A complete series of infraoculars 13
12. No complete series of infraoculars .. .. *formosa*
13. Fifth and sixth upper labials subocular .. .. *inornata*
14. Sixth and seventh or seventh and eighth upper labials subocular *kintorei*
15. 32–40 midbody scale rows .. .. *whitei whitei*
16. 40–46 midbody scale rows .. .. *whitei multiscutata*
17. Dorsal scales unicarinate .. .. *cunninghami*
18. Dorsal scales multicarinate 19
19. Less than 30 midbody scale rows; 5 or 6 supraciliaries .. .. *dorsalis*
20. More than 30 midbody scale rows; 6–10 supraciliaries 21

[1] Grooves present, but often difficult to distinguish in *inornata* and *kintorei*; specimens should be examined closely with a lens.

21. A complete series of infraoculars 23
22. No complete series of infraoculars 27
23. Dorsal scales obtusely bicarinate .. .. *frerei*
24. Dorsal scales obtusely tri- or quadricarinate 25
25. Dorsal colouration light brown; two grey dorso-lateral stripes *major major*
26. Dorsal colouration dark umber; bright yellow ventrally *major bungana*
27. Sixth and seventh upper labials subocular .. .. *kingii*
28. Fifth and sixth upper labials subocular .. .. .. *whitei napoleonis*
29. Caudal scales unicuspid .. .. *stokesii*
30. Caudal scales tricuspid .. .. *depressa*

EGERNIA WHITEI WHITEI (Lacepede).

Scincus whitii Lacepede, 1804, p. 192.

Egernia whitii Boulenger, 1887, p. 135.

Egernia whitei tenebrosa Condon, 1941, p. 111.

The characters used by Condon (1941, p. 111) to distinguish the melanic Kangaroo Island specimens as the subspecies *tenebrosa* are invalid. The separation of the parietals by the interparietal is a generic characteristic. One pair of enlarged nuchals is present in all Kangaroo Island specimens examined including the type (R2161). A percentage of South Australian mainland specimens are also melanic.

An examination of fifty specimens revealed the following variations. The midbody scale counts varying from 32–40, fell as follows: 32, (7 specimens); 33, (4 specimens); 34, (19 specimens); 35, (7 specimens); 36, (12 specimens); 37 (1 specimen); 38, (7 specimens); and 40, (2 specimens). With the exception of five specimens from Tasmania (R2895) all specimens have the nasals separated and the prefrontals forming a median suture. The Tasmanian specimens agree with the findings of Loveridge (1934, p. 336) and the collection of more material from Tasmania and Eastern Australia may reveal the separation of the prefrontals to be a character sufficiently constant to provide a basis for the designation of a separate subspecies. Usually seven upper labials (fifth and sixth subocular), but many possess eight (with the sixth and seventh subocular). Supraoculars five, with seven or eight supraciliaries. The basic colour pattern is fairly constant although sometimes partly or fully obscured by a uniformly dark grey or brown suffusion.

Average adult length: 215 (79+136) mm.

Distribution: Coastal districts of Eastern South Australia, Victoria, New South Wales, Tasmania and adjacent islands. Type locality, Australia (no exact data).

Loc. South Australia: R2573, Warcowie; R2896 (2 specimens), Coorong; R2897 (2 specimens), Yorke Peninsula; R2161 (holotype of *tenebrosa* Condon), R794, R1356 (3 specimens), R2665, R1185 (2 specimens), R1760 (6 specimens), R2907 (12 specimens), Kangaroo Island; R2901, Sweat Island, Pondalowie Bay; R2877 (3 specimens), Waitpinga; R1649, Basket Range; R1696 (2 specimens), West Island, Encounter Bay; R2918 (2 specimens), Neale Camp No. 1 (near Oodnadatta ?). Victoria: R1146, Nelson. Tasmania: R2895 (5 specimens), no exact data. Western Australia: R2980, between Victoria Springs and the Frazer Range.

EGERNIA WHITEI MULTISCUTATA Mitchell and Behrndt.

Egernia whitii multiscutata Mitchell and Behrndt, 1949, p. 176, fig. 2.

An examination of material from Eyre Peninsula, South Australia and several of the adjacent islands has revealed this race to have a more extensive distribution than was suspected originally. Typical specimens have now been examined from several localities on the mainland as well as from Thistle and Flinders Islands. The characters used to distinguish the Greenly Island specimens apply equally to this additional material.

Variations noted in the 31 specimens examined are as follows: Midbody scale counts 40, (2 specimens); 41, (2 specimens); 42, (8 specimens); 43, (11 specimens); 44, (5 specimens), and 46 (3 specimens). The general enlargement of the interparietal is evident in all specimens, it being in the extreme $1\frac{1}{2}\times$ as wide as the frontal. Whereas in the typical race many specimens were found to possess only seven upper labials, all specimens of *multiscutata* so far examined have eight with the sixth and seventh subocular. The basic colour pattern is similar to that of the type race although more striking and inclined to be broken up by irregularly distributed light edged scales in the insular populations. In two specimens the patterning is obscured by a darker colour.

Distribution: Eyre Peninsula, South Australia and adjacent islands.

Loc. South Australia: R2636, Greenly Island (holotype, allotype and eight paratypes); R2549 (2 specimens), Fishery Bay; R2547 (2 specimens), Thistle Island; R2902, R2903, R2905, R2906 (15 specimens), Flinders Island; R2908, Fowler Bay; R1274, Coffin Bay.

EGERNIA WHITEI NAPOLEONIS Gray.

Egernia napoleonis Gray, 1839, p. 290; Loveridge, 1934, p. 340.
Egernia pulchra Werner, 1910, p. 470.

Midbody scales in 36 rows (3 specimens); 37 rows (3 specimens); 38 rows (3 specimens); 40 rows (1 specimen). Supraoculars four, doubtfully five;

supraciliaries 7 or 8; 22–27 subdigital lamellae; a single pair of nuchal shields. Fifth and sixth upper labials subocular in nine specimens and the sixth and seventh in one specimen; 2–5 auricular lobules. Dorsal scales usually obtusely bi- or tri-carinate but almost smooth in four of this series.

A comparison of this material with Southern and Eastern Australian *whitei* has revealed a subspecific relationship, specimens such as W.A.M. R1384 with five upper labials anterior to the subocular and smooth dorsals being almost indistinguishable from *whitei whitei.* However, the average specimen is distinguishable by the obtuse keeling of the dorsal scales and the more constant presence of only four upper labials anterior to the subocular. The association of *napoleonis* with *whitei* is further confirmed by an examination of the palatal sutures, the condition in each case being identical. A gravid female taken in January, 1938 (W.A.M. R6799) contains two young in an advanced stage of development.

Werner's figure of *E. pulchra* (1910, fig. 6) is somewhat misleading, the snout being shown as depressed with a slightly projecting labial edge. This is not confirmed by the cotype [Michaelsen and Hartmeyer collection R11345 (W.A.M.)] or any of the other material examined, the snout being shorter and more rounded than in *whitei whitei.*

Distribution: South Western Australia. Type locality, Australia (no exact data).

Loc. Western Australia: W.A.M. R4517, Chorkerup; W.A.M. R266, R267, R268, Denmark; W.A.M. R3535, Ongerup; W.A.M. R1384, Stirling Range; W.A.M. R6799, R6800, Eclipse Island; W.A.M. R2563, Nanga Brook; Michaelsen and Hartmeyer Collection R11345—cotype of *E. pulchra* Werner (deposited in W.A.M.).

EGERNIA WHITEI CARNARAE Kinghorn.

Mr. Kinghorn has requested me to make the following correction in regard to the above name. The type of *E. whitei carnarae* (Kinghorn 1931), No. R9931 in the Australian Museum collection later proved to belong to the genus *Lygosoma,* and was redescribed and figured as *Lygosoma* (*Hinulia*) *breviunguis* (Kinghorn 1932).

Mr. Kinghorn writes, "An examination of the original of my manuscript shows that through carelessness in cutting out some notes on other species, the correction regarding *carnarae* and *breviunguis* was also deleted and the error overlooked until after the publication of the description."

A comparison of Kinghorn's figure and description of *breviunguis* (1932,

p. 301) with two specimens of *Lygosoma* (*Sphenormorphus*) *ocelliferum* Boulenger in the South Australian Museum Collection has verified the conclusion of Loveridge (1934, p. 344) that the two are synonymous.

EGERNIA INORNATA Rosen.

Egernia inornata Rosen, 1905, p. 139, fig. 3.
Egernia striata Sternfeld, 1919, p. 79.
Egernia kintorei (in part) Stirling and Zietz, 1893, p. 171.

Loveridge (1938, p. 187) raises a problem in regard to this species. He examined the gonads of a series of 24 specimens which he had formerly (1934, p. 337) referred to *inornata* Rosen and was led to the conclusion that this material was immature. He compares these with two adult specimens (one of which is gravid) from Officer Creek, South Australia, which have a higher number of midbody scale rows (viz. 46 and 48) and suggests that they may be adults of *inornata*. He was unable to adequately distinguish the two series on dermal characters. After an examination of the gonads of the specimens recorded in this paper the author was unable to repudiate or confirm the findings of Loveridge (1938), for although no positive sign of maturity was found, the gonads of several fresh specimens did appear to be fairly well developed.

Two juveniles and seventeen adults of a large lizard with 44–50 midbody scale rows are herein separated off under the name *E. kintorei* S. and Z., the main distinguishing feature being the possession of five or six upper labials anterior to the first subocular as compared with only four in *inornata*. The colouration of the lectotype of *kintorei* is very close to that described by Loveridge for his "adult *inornata*" specimens, and it is suggested that his two specimens may be referable to *kintorei*. It is expected that further collecting will reveal the adult size of *inornata* to be about 230 mm. Present locality data would seem to indicate that the distribution of *inornata* completely encloses and overlaps that of *kintorei*.

Notwithstanding the present data the status and relationship of the species and races in the *whitei-inornata-kintorei* group is very unsatisfactory and should make an interesting biogeographical study when more material is available for examination.

The two small specimens referred to *Egernia kintorei* by Stirling and Zietz, have been examined and found to belong to *inornata*.

Midbody scales in 36 rows (7 specimens); 38 rows (17 specimens); 40 rows (10 specimens); 42 rows (3 specimens)—smooth. Prefrontals making a short

median suture; upper labials constantly seven, fifth and sixth subocular; interparietal short and wide, as wide as or wider than the frontal. Post-narial groove generally absent but a very faint groove is evident around the posterior edge of the nostril in several specimens. Sub-narial groove invariably present, but faint in some specimens.

The ground colour varies from rust-red through pink-tinged cream to light fawn. Dorsal surface uniformly coloured, irregularly speckled with black or with regular longitudinal striations. Some specimens have a continuous dark dorso-lateral stripe and two have continuous black vertebral stripes. Both of these stripes are generally broken into irregular spots. Ventral surfaces white.

Measurements of the largest specimen: 158 (96+62) mm.—tail incomplete.

Distribution: Central Australia—probably occurs in the inland districts of all mainland States with the possible exception of Victoria.

Type locality: West Australia (no exact data).

Loc. South Australia: R2914 (10 specimens), Mt. Burrell Station; R557, Purnong; R754, near Tingatingana; R22 (2 specimens), Bow Hill, River Murray; R692 (3 specimens), 408-mile station, East-West Railway; R602, Oodnadatta; R2917 (11 specimens), Neale Camp No. 1 (near Oodnadatta?). Western Australia: R2915, Frazer Ranges; R2916, between Victoria Springs and Frazer Ranges. Northern Territory: R2918 (6 specimens), Tennant Creek; R321, Macdonnell Ranges.

EGERNIA KINTOREI Stirling and Zietz.

Egernia kintorei Stirling and Zietz, 1893, p. 171.
Egernia dahlii Boulenger, 1896, p. 233; Werner, 1909, p. 42.

The large specimen whose measurements and colouration were described by Stirling and Zietz is here designated the lectotype and as a consequence *E. dahlii* Boulenger is, as was suspected by Loveridge (1934, p. 337) a synonym of it. As has already been pointed out the two small paratypes of *kintorei* are referable to *inornata* Rosen.

Redescription: Body short, stout, the adpressed limbs slightly overlapping; the distance between the tip of the snout and the forelimb is contained once and one-half in the distance between the axilla and the groin. Snout short, rounded; with two vertically rectangular loreals; nostrils pierced in the nasals which are separated on the midline by the fronto-nasal which forms a suture with the rostral. A sub- and a faint post-narial groove present. Prefrontals forming a median suture. Five supraoculars, second largest, as wide as the

frontal; nine or ten supraciliaries, first largest. First and second supraoculars contacting the frontal. Fronto-parietals form a large median suture; interparietal as long as and slightly wider than the frontal; parietals short and wide. A complete series of infraoculars and one pair of enlarged nuchal shields present. Eight upper and ten lower labials, the eighth upper largest and the sixth and seventh subocular. Ear opening oval, as long as the eye opening with five rounded lobules anteriorly. Dorsal and lateral scales smooth or faintly striated; forty-six at midbody; dorsals slightly larger than the laterals and ventrals.

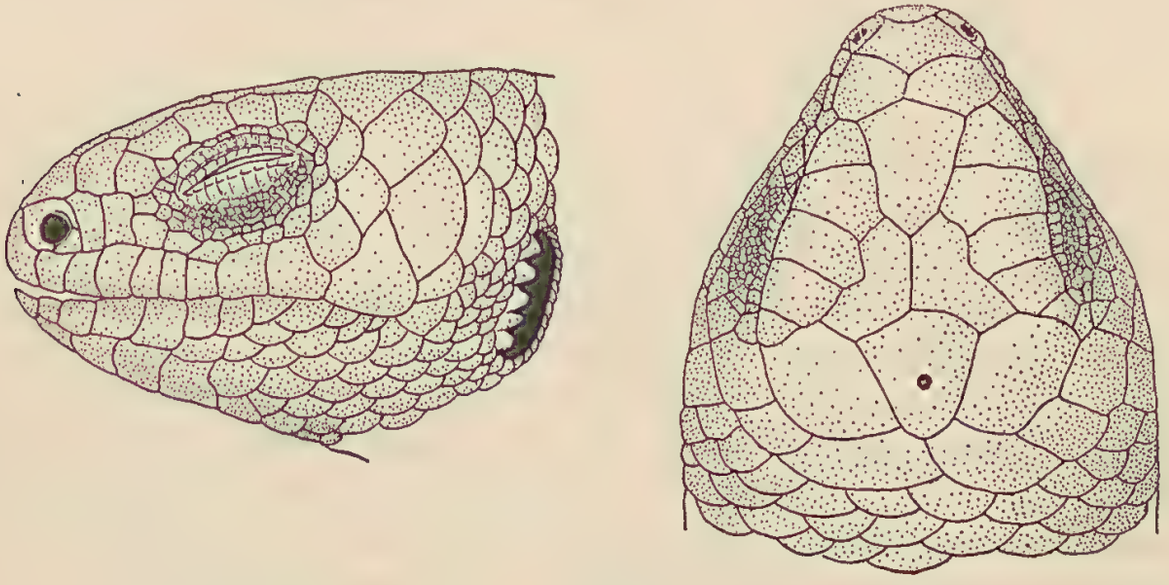


Fig. 2. *Egernia kintorei* Stirling and Zietz: dorsal and lateral views of the head—adapted from the lectotype.

Colour: Red brown above with faint darker lines running longitudinally between the series of scales. Faint vertical barring on the flanks. Ventral surfaces pale yellow.

Measurements: Owing to the position in which the body has set it is difficult to obtain accurate measurements and therefore those of Stirling and Zietz are quoted. Total length, 360 mm.; head, 35 mm.; body, 150 mm.; tail, 175 mm.; length of forelimb, 55 mm.; length of hind limb, 60 mm.

In addition to the lectotype, eighteen specimens were examined and the following variation noted. Midbody scales in 44 rows (3 specimens); 46 rows (9 specimens); 48 rows (4 specimens); 50 rows (2 specimens). The postnarial groove is constantly present, but very faint in several specimens. The scalation on one side of the head of lectotype is irregular, several of the major scales being subdivided. A number of specimens possess slightly enlarged

anal plates and one has two instead of the usual single pair of nuchals. The majority of adult specimens are coloured uniform pale yellow in spirit with no darker markings. Two juvenile specimens have a red and yellow mottling on the dorsal surface, and conspicuous vertical barring on the flanks.

Distribution: Central and North-western Australia—probably also occurs in Western New South Wales and Queensland.

Loc. Western Australia: R2925, Northern Victoria Desert (lectotype); R2923 (5 specimens), Calvert Expedition. South Australia: R2114, Innamincka; R2920 (3 specimens), Neale Camp No. 1 (near Oodnadatta?). Northern Territory: R2921 (6 specimens), no exact data; R2922 (3 specimens), Tennant Creek.

EGERNIA STRIOLATA STRIOLATA (Peters).

Tropidolepisma striolatum Peters, 1870, p. 642.

Although originally recorded as being restricted to Queensland this species appears to be widely distributed in Eastern, Southern and South-western Australia. Fourteen specimens of the type race were examined, twelve from South Australia and two from Queensland.

Midbody scales in 30 rows (6 specimens); 32 rows (4 specimens); 34 rows (4 specimens),—dorsals obtusely tri- or quinquecariante, almost smooth in several of the South Australian examples. Prefrontals usually forming a short median suture but separated in Queensland Mus. J7425; nasals separated or making point contact; eight upper labials with the sixth and seventh subocular; a series of laterally expanded upper caudals usually starts 5–9 scales along the tail from the level of the vent—R2910 has no laterally expanded upper caudals.

General ground colour of the two Queensland specimens is grey-brown; a dark vertebral stripe on the nape breaks up into six longitudinal series of quadrangular markings each half the width of a scale. There is also a dark dorso-lateral stripe extending down each side of the body which breaks up about half way along into an irregular series of dark spots. Ventral surfaces lighter, with an irregular series of darker markings under the throat; upper labials and auricular lobules white.

The South Australian material differs in having a much lighter ground colour and the dark dorso-lateral stripes extend only to above the forelimb where they fade uniformly into the ground colour. The longitudinal series of quadrangular spots are much narrower, each being only about one quarter the width of a scale and are restricted to a mid-dorsal sequence of three or four rows. Between this sequence and the dark dorso-lateral stripe is a uniformly coloured light band which is well defined near the nape. No darker ventral markings.

Average adult length. 227 (104 + 123) mm.

Distribution. Queensland, New South Wales, Victoria and South Australia. Type locality, Lake Elphinstone, Queensland.

Loc. Queensland: Qld. Mus. J263, Toowoomba; Qld. Mus. J7425, South Pine River. South Australia: R2909 (3 specimens), Morgan; R2910, Ooldea; R2625, Burra; R2911 (2 specimens), Mern Merna; R2912, Flinders Ranges; R2913, Kilkenny, Adelaide; R965, Henley Beach, Adelaide; R2055, Payneham, Adelaide.

EGERNIA STRIOLATA NITIDA (Gray).

Tropidolepisma nitida Gray, 1845, p. 106.
Egernia carinata Smith, 1939, p. 11, fig. 3.

A comparison of the variation shown by this series of 28 specimens with that of the fourteen typical *striolata* examined indicates that the two are subspecifically related. The two specimens R2894 would appear to be in the zone of intergradation between the typical race and *nitida*. Also, a comparison of Smith's excellent figure and description of *carinata* (1939) with the present subspecies reveals the two to be synonymous.

Midbody scales in 30 rows (4 specimens); 31 rows (1 specimen); 32 rows (5 specimens); 34 rows (7 specimens); 35 rows (4 specimens); 36 rows (5 specimens); 37 rows (1 specimen) and 38 rows (1 specimen)—dorsals tricarinate with occasional quadri- and quinquecarinate scales on the anterior third of the body; the keeling varies from very acute to obtuse, the two conditions sometimes occurring in the one specimen. Interparietal narrower than, but almost as long as the frontal; prefrontals narrowly separated or forming a short median suture; nasals separated or making point contact on the midline; two or three pair of pluricarinate nuchals. Four, doubtfully five supraoculars; 6–8 supraciliaries; 2–4 white auricular lobules; 20–24 lamellae beneath the fourth toe. Generally five upper labials anterior to the first subocular, but in three specimens only four; laterally expanded uppercaudals seldom occur on the anterior half of the tail.

Dorsal ground colour grey-brown, with an ill-defined dark dorsolateral stripe extending from the temporal region to about half way along the body where it breaks up into an irregular series of spots. Three to five longitudinal series of quadrangular spots, each half the width of a scale extend along the body and often along the tail also. In several specimens these spots have lost their serial arrangement and are scattered irregularly, while in others the spots are without the angular form typical of the average specimen; labia and auricular

lobules light, each labial with a dark perimeter. In two very dark specimens there are numerous white-edged scales on the lateral surfaces and a white spot in the centre of each labial.

Two specimens from Eclipse Island (W.A.M. R6801, R6802) have a distinctive colour pattern which seems worthy of description. The scalation of these two specimens does not differ appreciably from an average example but it is noted that the frontal and interparietal are of similar size and shape. Midbody scales, 36 in both specimens. General ground colour olive-green; the black dorsolateral lines extend from the temporal region to above the hind limb where each becomes broken into a double series of spots along the tail. The series of quadrangular dorsal spots have become fused into three continuous but irregular longitudinal lines each two scales wide. Majority of head shields dark edged; ventral surfaces uniform blue-grey; labia and auricular lobules light.

Distribution. South-western Australia and adjacent islands. Type locality, Australia (no exact data).

Loc. Western Australia: W.A.M. R6801, R6802, Eclipse Island; W.A.M. R6058, Waddington; W.A.M. R8014, Norseman; W.A.M. R6103, R6104, R6109, Kukerin; W.A.M. R1533, R1534, R1535, R1536, Tambellup; W.A.M. R1163, R1164, R1165, R1166, R1167, R8374, Bridgetown; W.A.M. R6816, Witchcliffe; W.A.M. R6788, Albany; W.A.M. R4486, Chorkerup; W.A.M. R4604, Margaret River; W.A.M. R1998, R818, Stirling Range; W.A.M. R4366, Wandering; W.A.M. R265, Kent River. Also R2894 (2 specimens), between Frazer Range and Southern Cross.

EGERNIA FORMOSA Fry.

Egernia formosa Fry, 1914, p. 184; Loveridge, 1934, p. 338.

Nasals and prefrontals forming short median sutures or separated. Four doubtfully five supraoculars; 7–8 supraciliaries; two or three pair of enlarged nuchals. Four upper labials anterior to the first subocular; 28 or 30 (Loveridge, 1934 records 28–32) faintly striated midbody scales; 18–20 transverse lamellae under the fourth toe. Loveridge (1934) examined seventeen specimens and was unable to find any post-narial grooves. These are definitely present in this material. The colouration agrees generally with Fry's description and is constant enough to provide an excellent guide for ready identification.

Fry draws attention to the resemblance of *formosa* to *striolata,* but using Werner's key (1910, p. 472) compares it with *luctuosa* and its synonym *lauta,* herein placed in the genus *Tiliqua*: these are comparatively remote from *formosa* which would seem to have been derived from similar stock to *striolata.* The distribution of all three species overlap in South-western Australia.

Unfortunately three of the four specimens examined are without exact locality data, one of these being the cotype figured by Fry (1914, fig. 4).

Distribution. South Western Australia and adjacent islands. Type locality, Perth, Western Australia.

Loc. Western Australia: W.A.M. R16, R17, no exact data; R4209, Bulong, near Kalgoorlie; also an unregistered cotype with serial No. 456 attached (W.A.M.).

EGERNIA MAJOR MAJOR (Gray).

Tropidolepisma major Gray, 1845, p. 107.

Midbody scale rows 34 and 36, obtusely tri- or quadricarinate; seven or eight upper labials with the fifth and sixth or sixth and seventh subocular; posterior loreal almost square; three pair of enlarged nuchals. Ear opening oval,

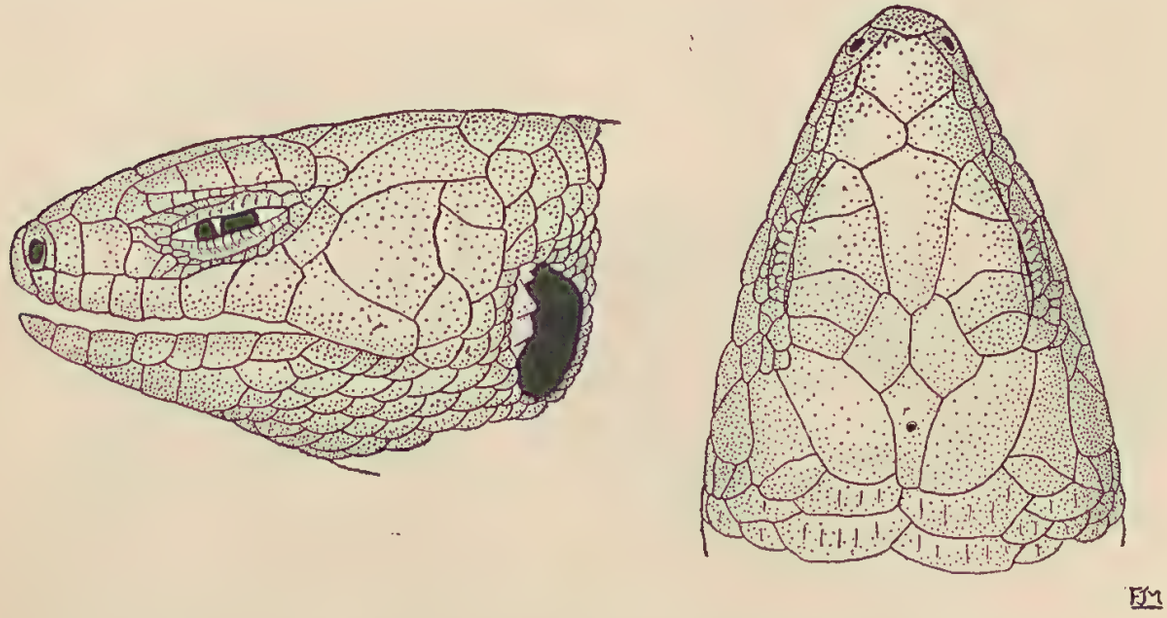


Fig. 3. *Egernia major major* (Gray): dorsal and lateral views of the head.

two thirds the eye opening, with three or four obtuse lobules anteriorly; four doubtfully five supraoculars; eight or nine supraciliaries. A series of laterally expanded upper caudals, similar to those of *striolata,* present toward the tip of the tail. Colour uniform light brown dorsally, with a light grey dorso-lateral stripe. Ventral surfaces yellowish-grey.

Largest specimen (R356). 327 (152 + 175) mm.

Distribution. Northern and Central Queensland; Northern Territory. Type locality, Australia (no exact data).

Loc. Queensland: R356, Stewart River; Northern Territory: R1129, Roper River.

EGERNIA MAJOR BUNGANA De Vis.

Egernia bungana De Vis, 1887, p. 814; Longman, 1918, p. 37, pl. xiii.

Loveridge (1934, p. 338) rightfully throws doubt on the status of this lizard. The author has examined two specimens, an adult and a juvenile from the type locality, Mt. Tambourine, South Queensland, and like Longman (1918, p. 37) has been unable to find any concrete characters which distinguish it readily from *major*, other than the distinctive colouration and the larger size. There are several scalation differences between these specimens and those referred to *major major* above, but owing to the inadequacy of the material available for examination their validity as distinguishing characters could not be tested. However, on present evidence it seems probable that *bungana* will prove to be a good subspecies when more material is available.

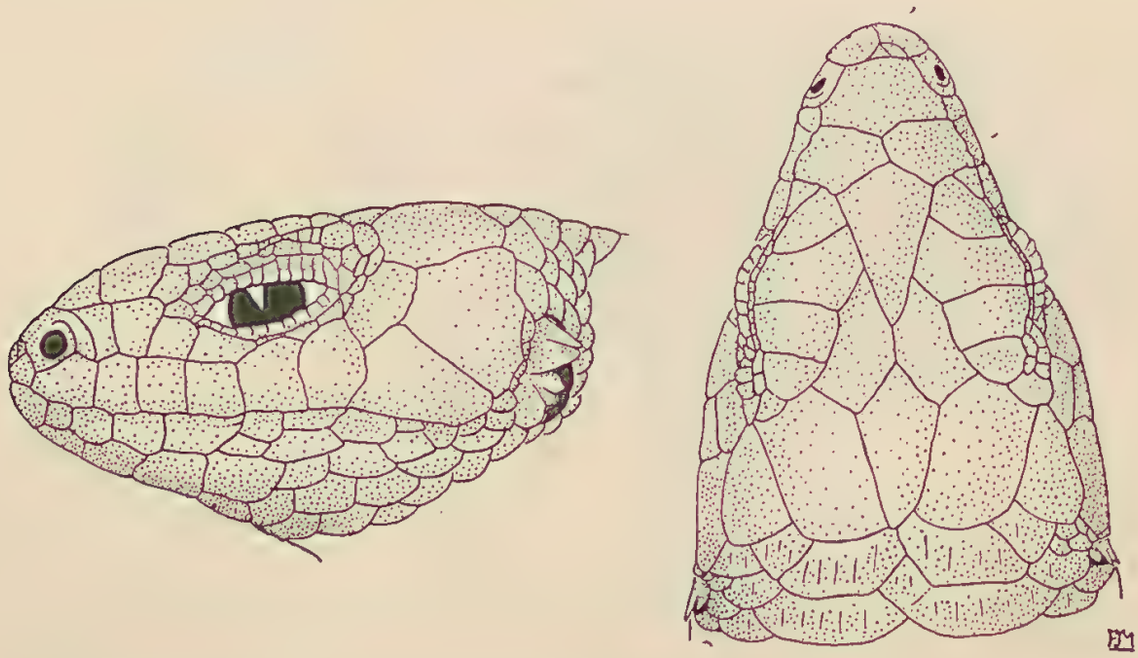


Fig. 4. *Egernia major bungana* De Vis: dorsal and lateral views of the head.

Midbody scales 28; seven upper labials with the fourth, fifth and sixth subocular; posterior loreal is somewhat rhomboidal; four pairs of enlarged nuchals. Ear opening crescentic, only half the eye opening, with three large acute lobules completely obscuring it. Four, doubtfully five supraoculars; ten or twelve supraciliaries. The dorsal colouration is uniform dark umber, almost black, becoming broken and speckled with yellow ventro-laterally to bright lemon yellow ventrally. In the juvenile specimen the lateral surfaces of the body and

tail have occasional white centred scales; also one or two on the sides of the head and neck.

Measurements of adult. 595 (270 + 225) mm.—tail damaged.

Loc. Queensland: R2924, Qld. Mus. J6831, Mt. Tambourine (type locality).

EGERNIA FREREI Gunther.

Egernia frerei Gunther, 1897, p. 405.

This Queensland species appears to be most nearly allied to *E. major*, differing in the possession of obtusely bicarinate dorsal scales, the absence of a postnarial groove and in having a slightly more elongate frontal. Midbody scales in 34 rows. No specimens of this species were examined.

Type locality, Bartle Frere Mountains, Queensland.

EGERNIA DORSALIS (Peters).

Tropidolepisma dorsale Peters, 1873, p. 743.

Egernia rugosa De Vis, 1887, p. 815.

A single specimen from Mungallala, South Queensland (Qld. Mus. J5895) was examined and compared with the description of *rugosa* De Vis (1887). It is concluded that *rugosa* is conspecific with *dorsalis*; the few distinguishing features evident from the description being of an unsatisfactory nature as they have been shown to be very variable within specific limits in other cases.

Dorsal scales quadri- or quinquecarinate, 26 rows at midbody; upper head scales rugose, often subdivided (see fig. 5). Two or three large triangular lobules

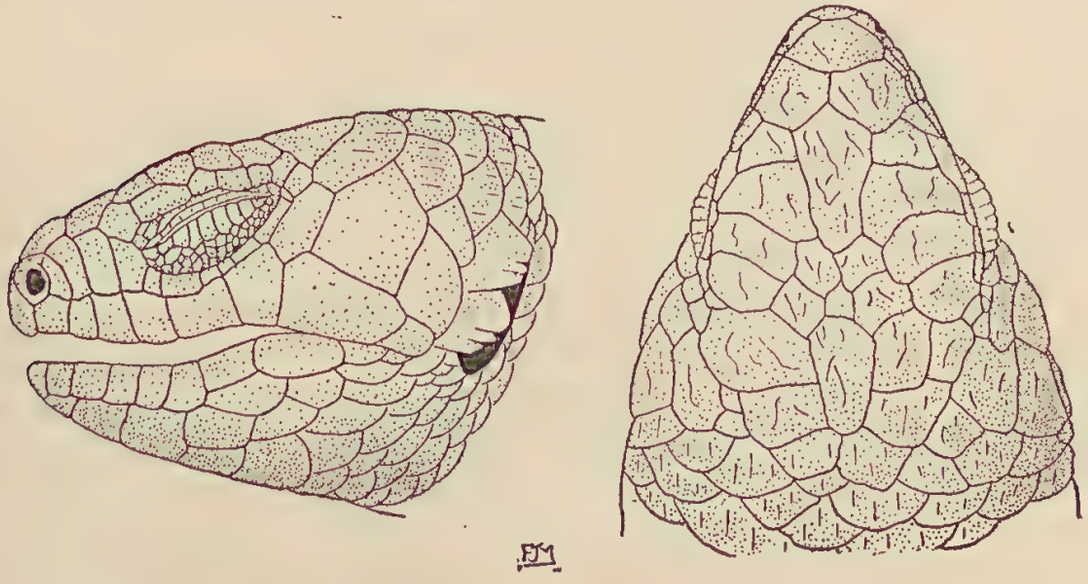


Fig. 5. *Egernia dorsalis* (Peters): dorsal and lateral views of the head.

largely obscure the ear opening; four, doubtfully five supraoculars; five or six supraciliaries. A series of enlarged nuchals and vertebrals present but separated from the parietals by several series of scales (see fig. 5). Adpressed limbs slightly overlapping.

Measurements. 435 (203 + 232) mm.—tail complete.

EGERNIA KINGII (Gray).

Tiliqua kingii Gray, 1839, p. 290.

Midbody scales 34–36; dorsals tri- or quadricarinate. Upper labials irregular—7 + 8 in R97 and 9 + 9 in R242 with the fifth and sixth or sixth and seventh subocular.

Measurements of the larger specimen (R97): 380 (200 + 180) mm.—tail regenerating.

Distribution. Coastal districts of Western and North-western Australia; adjacent islands. Type locality, Australia (no exact data).

Loc. Western Australia: R97, no exact data; R242 Abrolhos Islands.

EGERNIA CUNNINGHAMI (Gray).

Tiliqua cunninghami Gray, 1832, p. 40.

?Egernia lohmanni Werner, 1917, p. 32.

Midbody scales 36–44, very strongly unicarinate and spinous. Eight or nine upper labials with the sixth and seventh or seventh and eighth contacting the lower eyelid.

Largest specimen (R2933): 322 (162 + 160) mm.

Distribution. Suitable areas in all mainland states. Type locality, West Australia (lat. 29°).

Loc. South Australia: R2127, Monreith; R2304, Aldinga; R950, Mylor; R2930, Burnside, Adelaide; R2931, Mt. Lofty Ranges; R2932, Gawler; R2933, Lyndoch—also ten specimens without locality data.

Egernia lohmanni Werner (1917, p. 32) appears to be very closely allied to if not synonymous with the present species. From Werner's description (1917, p. 32) it appears to differ in having only the seventh upper labial contacting the eyelid, less spinous dorsal and caudal scales and in possessing a series of laterally expanded upper caudal scales. As pointed out by Loveridge (1934, p. 341) a probable explanation of this latter character is a reproduced tail. Laterally expanded upper caudals are evident in some reproduced sections of the tail in *major, formosa* and *kingii*. In all other scale details and in colour pattern it agrees closely with *cunninghami*.

EGERNIA STOKESII (Duméril).

Silubosaurus stokesii Duméril, 1851, p. 180.

The forty-four specimens examined showed the following variations. Midbody scales in 32 rows (9 specimens); 34 rows (25 specimens); 36 rows (10 specimens); nasals separated or just contacting medianly; prefrontals with a long or short median suture. Dorsal and caudal scales generally unicuspid although some specimens show bilateral keels.

Measurements of an average adult. 240 (168 + 72) mm.

Distribution. Widely distributed in Western and Central Australia. Probably occurs in the drier parts of all mainland states except Victoria. Type locality, Houtman's Abrolhos, Western Australia.

Loc. South Australia: R1797, Quorn; R2060, R2929 (2 specimens), Port Augusta; R1480, Cludamook Station, East-West Railway; R2928, 20 miles north of Macumba Creek; R98, Mern Merna; R2335, Nackatoo; R2119, Pygery; R1278 (2 specimens), Owieandana; R575, Moolooloo. Northern Territory: R314 (5 specimens), Macdonnell Ranges. Western Australia: R243, R244, R245, Abrolhos Islands. Also fourteen specimens without locality data.

EGERNIA DEPRESSA (Gunther).

Silubosaurus depressus Gunther, 1875, p. 15.

Midbody scales in 30–36 rows, tricuspid; frontonasal making contact with or separated from the rostral; post-narial suture completely dividing the nasal shield.

Measurements of an average adult. 153 (109 + 44) mm.

Distribution. South Western Australia. Type locality, Swan River, Western Australia.

Loc. Western Australia: R2926, Murchison District; R2927 (6 specimens), between Ashburton and Gascoyne Rivers; R167, Beverley.

The close superficial resemblance of this species to *E. stokesii* suggests at once the possibility of their being subspecifically related; they seem to share, however, a common area of distribution.

TILIQUA Gray (1825, p. 201).

Trachysaurus Gray, 1827, p. 430.
Cyclodus Wagler, 1828, tab. 6; 1830, p. 162.
Brachydactylus Smith, 1835, p. 144.
Cyclodomorphus Fitzinger, 1843, p. 23.
Omolepida Gray, 1845, p. 87.
Trachydosaurus Gray, 1845, p. 102.
Hemisphaeriodon Peters, 1867, p. 24.

Apart from the osteological characters drawn attention to in the introductory chapter, the species of *Tiliqua* show the following differences from those of *Egernia*.

Lateral teeth generally less than thirty-five in number with obtusely conical or spheroidal crowns, not recurved; pterygoids toothless. The palatine bones are on the whole not as widely separated and actually make contact in several species. The general form is a little more elongate; the scalation is very similar to that of *Egernia*.

KEY TO THE SPECIES AND SUBSPECIES OF *TILIQUA*.

1. Tail much shorter than the head and body; a complete series of suboculars 5
2. Tail almost as long as or longer than the head and body; with or without a complete series of suboculars 3

3. A complete series of suboculars .. .. *luctuosa*
4. An incomplete series of suboculars 19

5. Tail depressed, stump-like .. .. *rugosa*
6. Tail tapering uniformly to a point 7

7. Tail subcylindrical 9
8. Tail compressed .. .. *adelaidensis*

9. Anterior temporals much larger than others 11
10. Anterior temporals subequal to others 15

11. 28–34 scales at midbody 13
12. 34–40 scales at midbody .. .. *scincoides scincoides*

13. Forelimb longer than the head .. .. *scincoides gigas*
14. Forelimb shorter than the head .. .. *scincoides keiensis*

15. 28–30 midbody scales .. .. *nigrolutea*
16. 38–42 midbody scales 17

17. 4–7 darker body bands .. .. *occipitalis occipitalis*
18. 11–15 darker body bands .. .. *occipitalis multifasciata*

19. Post-narial groove present 21
20. Post-narial groove absent 23

21. 22–26 scales at midbody .. .. *branchiale branchiale*
22. 28 scales at midbody .. .. *branchiale woodjonesii*

23. Body and tail with dark transverse bands .. .. .. *gerrardii*
24. Body and tail without dark transverse bands 25

25. Ear lobules inconspicuous or absent .. .. *casuarinae casuarinae*
26. Ear lobules conspicuous—one or more .. .. .. *casuarinae petersi*

TILIQUA SCINCOIDES SCINCOIDES (Shaw).

Lacerta scincoides Shaw, 1790, 242, fig.

Midbody scales in 34–38 rows; prefrontals forming a median suture; nasals generally contacting medianly. Seven to nine darker cross-bands on the body and seven to ten on the tail.

The four specimens from Queensland and Groote Eylandt are much longer than the average South Australian adult of this species and they possess a distinctive colour pattern. An examination of a larger series may reveal them to be subspecificially distinct.

Average adult length. 441 (293 + 148) mm.

Distribution. All states of Australia including Tasmania; Islands in the Torres Straits. Type locality, Australia (no exact data).

Loc. South Australia: R52, Ironbark; R190, Bridgewater; R191, Glen Osmond; R263, Mt. Compass; R290, Mt. Pleasant; R520, Moolooloo; R643, Torrens Gorge; R635, Kangarilla; R644, Mt. Lofty Ranges; R1311, St. Peters, Adelaide; R1491, Payneham, Adelaide; R1473, Smoky Bay; R1578, Native Valley; R1730, Happy Valley; R2052, Avenue Ranges; R2061, near Pt. Augusta; R2070, Willunga; R2097, Auburn; R2103, Kersbrook; R2149, Morphett Vale; R2125, Delamere; R2149, Norwood, Adelaide; R2218, Nuriootpa; R2490, Myponga; R2491, Campbelltown; R2492, South-Eastern South Australia; R2493, Quorn; R2501, Cherry Gardens. (Owing to the shortage of storage space many of the specimens of this common South Australian species were not retained after identification.) Queensland: R199, Bundaberg; R349, R350, Stewart River. Northern Territory: R1134, Groote Eylandt.

TILIQUA SCINCOIDES GIGAS (Schneider).

Scincus gigas Schneider, 1801, p. 202.

Tiliqua scincoides gigas Loveridge, 1948, p. 339.

A single juvenile specimen was examined. Midbody scales in 32 rows; interparietal much narrower than the parietals and shorter than the anterior temporals; median dorsal and caudal scales smooth. The fifth, sixth and seventh upper labials subocular (De Rooij, 1915, p. 157, figures sixth, seventh and eighth subocular). The length of the forelimb goes $1\frac{3}{4}$ times into the axilla-groin measurement. Body traversed by 7–8 narrow black bands.

Measurements of this specimen. 144 (90 + 54) mm.

Measurements of an adult specimen. 557 (312 + 245) mm.—De Rooij, 1915.

Distribution. New Guinea, Java, Sumatra(?), and many of the adjacent islands. Type locality, Amboina Island, off Ceram.

Loc. R1639, Tanpora Island, near the south-eastern tip of New Guinea.

Loveridge (1948, p. 339) has concluded from the presence of *keiensis* Oud. that *gigas* is only a subspecies of *scincoides*. Although the above possibility is not disputed, the supposedly self-contained ranges of the various forms being suggestive of a chain of subspecies, the presence of a morphologically intermediate form isolated on an island does not necessarily eliminate the possibility of the two lizards being specifically distinct. Subspecific relationship is tentatively accepted until more data is available for consideration.

TILIQUA GERRARDII (Gray).

Hinulia gerrardii Gray, 1845, p. 75.

Midbody scales in 32 rows; sixth upper labial entering the orbit, sixth and seventh subocular.

Measurements of an adult specimen. 345 (148 + 197) mm.

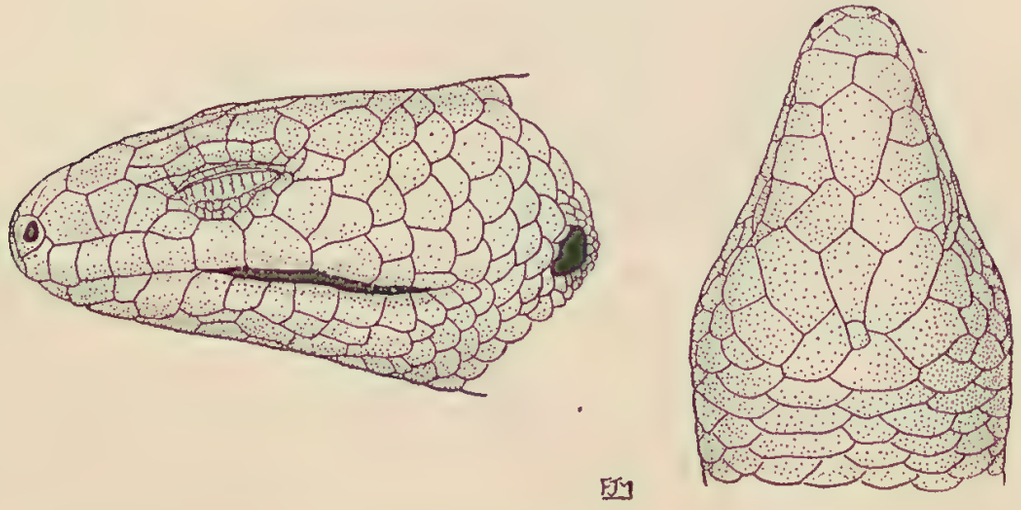


Fig. 6. *Tiliqua gerrardii* (Gray): dorsal and lateral views of the head.

Distribution. Inhabits the eastern coastal country of Queensland and northern New South Wales. Australian and Queensland Museum locality records indicate a distribution as far south as Wingham, New South Wales and north to Rockhampton in Queensland. Type locality, Australia (no exact data).

Loc. Queensland: R2934, Herston, Brisbane.

This specimen was received in exchange from the Queensland Museum where it was registered as J4611.

TILIQUA OCCIPITALIS OCCIPITALIS (Peters).

Cyclodus occipitalis Peters, 1863, p. 231.

Midbody scales in 38 rows (4 specimens); 40 rows (7 specimens); 42 rows (3 specimens); supraoculars 2 or 3; supraciliaries 5 or 6. Median suture of the prefrontals varying from point contact to half the length of the frontonasal; nasals narrowly separated behind the rostral. As with other species in this genus the forelimb into axilla-groin ratio varies greatly with the age of the specimen. Darker body bands 4–7, tail bands 3–4.

Measurements of an average adult. 401 (287 + 114) mm.

Distribution. Southern parts of Western Australia, South Australia and New South Wales; also northern Victoria. In spite of the reference by Waite (1929, p. 146) to this species as "somewhate rare" in South Australia it appears to be quite abundant on the coastal flats north of Adelaide where it occurs to the exclusion of the more common *scincoides*. Type locality, Adelaide, South Australia.

Loc. South Australia: R394, Strathalbyn; R2740, Murray River; R2741 (6 specimens), Balhannah; R2742, Tintinara; R3010, Port Parham, R3011, Lower Light—also registered as having been taken at R189, Milang; R960, One Tree Hill; R977, Berri and R1021, Murray Bridge. Western Australia: R2718, R2719, R2720, Frazer Range; R2722, between Ashburton and Gascoyne Rivers. New South Wales: R2743, Wentworth.

TILIQUA OCCIPITALIS MULTIFASCIATA Sternfeld.

Tiliqua occipitalis multifasciata Sternfeld, 1919, p. 79; Loveridge, 1934, p. 343.

Tiliqua occipitalis auriculare Kinghorn, 1931, p. 88.

Typical specimens of this well defined race are readily distinguishable from the nominate form by the much larger ear opening, partial separation of the frontoparietals by the interparietal and the distinctive colouration. Midbody scales in 38–42 rows (Kinghorn, 1931 records 45 for *auriculare*); 12–15 darker bands on the body, 11–13 on the tail.

Five specimens (R2746) are labelled as having been the complete brood of a female (R2745) from Tennant Creek, Northern Territory. These five specimens appear to have been preserved soon after birth, their umbilical areas being still protrusive. They measure 100–108 mm. and were taken in April.

Fig. 7 is of one of these juveniles and it illustrates the relative size of the ear opening and the partial separation of the frontoparietals.

Distribution. Has been recorded from North-western Australia, Northern Territory and south to Killalpaninna Mission Station in South Australia at which station it was known to the natives as [jidna]. Probably also occurs in South-western Queensland, Northern and Central New South Wales. Type locality, Hermannsburg Mission, Northern Territory.

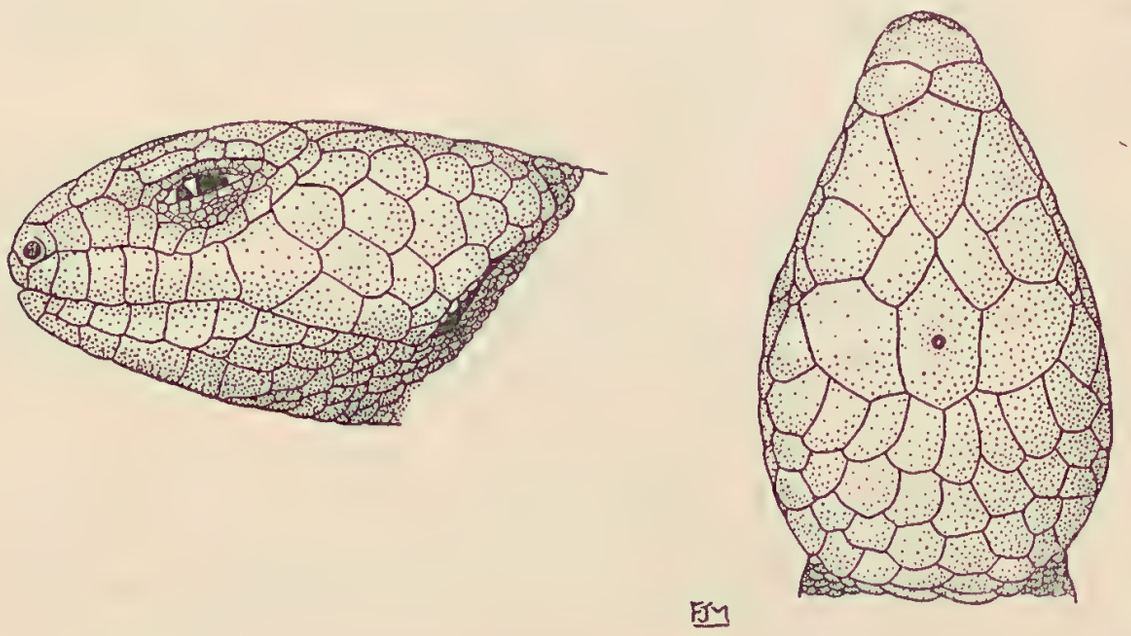


Fig. 7. *Tiliqua occipitalis multifasciata* Sternfeld: dorsal and lateral views of the head of a juvenile.

Loc. Northern Territory: R2744, R2745, R2746 (5 specimens), R2747 (3 specimens), Tennant Creek; R2723, R2724, unlocalized; R323, Macdonnell Ranges. South Australia: R2736, Killalpaninna Mission Station.

TILIQUA NIGROLUTEA Gray.

Tiliqua nigroluteus Gray, 1831, p. 68.

Midbody scales 28 or 30; four supraoculars; five or six supraciliaries.

Measurements of an average adult. 376 (251 + 125) mm.

Distribution. This species has been recorded from South-eastern South Australia, Victoria, South-eastern New South Wales, Tasmania and islands in Bass Strait. Loveridge (1934, p. 343) also records a specimen without localized data from Western Australia. Type locality, Australia (no exact data).

Loc. South Australia: R1801, Mt. Gambier; R2748, Robe. Tasmania: R268, Flinders Island.

TILIQUA LUCTUOSA (Peters).

Cyclodus (*Omolepida*) *luctuosus* Peters, 1866, p. 90.

Egernia lauta De Vis, 1887, p. 873.

Egernia luctuosa Boulenger, 1887, p. 135.

An examination of the type specimen of *E. lauta* De Vis (Qld. Mus. J249) has revealed it to be synonymous with *luctuosa*, now more correctly placed in the genus *Tiliqua*; the condition of the palatal sutures and the general form support this transfer (see fig. 1).

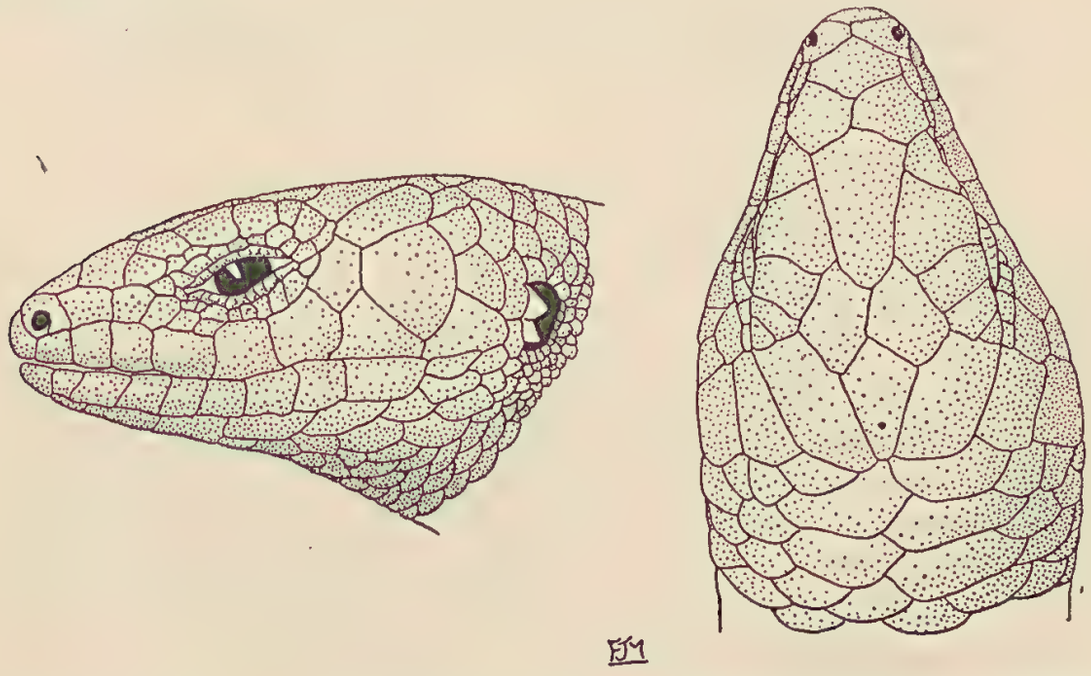


Fig. 8. *Tiliqua luctuosa* (Peters): dorsal and lateral views of the head of the holotype of *Egernia lauta* De Vis.

Midbody scales in 24 rows (4 specimens); 25 rows (2 specimens), 26 rows (3 specimens); supraoculars four, doubtfully five in some specimens; 7–9 supraciliaries; two or three pair of enlarged nuchals. It is noted that the type specimen of *lauta* has 24 and not 28 midbody scale rows as was indicated in the type description. Nasals separated or making contact on the midline; prefrontals forming a variable length median suture. Limbs meeting or slightly overlapping when adpressed; 23–27 undivided lamellae beneath the fourth toe. A subnarial groove extends up the posterior border of the nostril for some distance before joining it, and thus could be accepted as a postnarial groove.

Measurements of an average adult. 289 (109 + 180) mm.

Distribution. Originally recorded from King George Sound, North Western Australia, this species appears to be common in South-western Australia,

and the record of *lauta* would seem to indicate a distribution extending across the Northern Territory into Queensland.

Boulenger (1887, p. 135) records two specimens of this species and five of *E. kingii* from South Australia. Neither of these species are represented by local material in the South Australian Museum collection and it would seem possible that Boulenger's material was taken in the Northern Territory which politically was once part of South Australia. Both species were collected by a Dr. Fletcher. Type locality, King George Sound, Western Australia.

Loc. Queensland: Qld. Mus. J249, unlocalized (Type of *E. lauta* De Vis). Western Australia: W.A.M. R8476, Denmark; W.A.M. R4419, Chorkerup; R11464, R11465, R11466, Albany; R758, Leederville; R2786, Maylands. (Also one unregistered specimen from the Michaelsen and Hartmeyer collection.)

TILIQUA ADELAIDENSIS (Peters).

Cyclodus adelaidensis Peters, 1863, p. 232; Strauch, 1866, p. 458.
Tiliqua adelaidensis Boulenger, 1887, p. 148; Waite, 1929, p. 146.

Since the description of this species by Peters in 1863 considerable doubts as to its validity have been cast, it being mentioned by Waite (1929, p. 146) quoting the suggestion of Lucas and Frost (?) that *adelaidensis* was described from a juvenile of one of the larger species, possibly *T. occipitalis* Peters.

Six specimens of this rare species have now been found reposing under various names in the South Australian Museum Collection and from these a topotype has been chosen and a detailed redescription compiled from it. Three of these specimens are unfortunately without adequate locality data, having been labelled by A. Zietz "*Omolepida* or *Egernia* sp.—Central South Australia." The topotype (R2229), a specimen from Dry Creek, South Australia (now an outer suburb of Adelaide) had been wrongly identified as *Egernia whitei* var. a species to which it bears little resemblance. The remaining two specimens were received from near Burra, South Australia in 1945.

In his synopsis of the species of *Tiliqua* (1937, p. 232) M. A. Smith gives the range of *Tiliqua adelaidensis* as "Australia and Tasmania." If correct, this would indicate that he had examined specimens from Tasmania, because as far as I am aware the only previously recorded specimens are Peters' type and a specimen in the British Museum recorded by Gunther (1867, p. 48) and Boulenger (1887, p. 148). Both were taken at or near Adelaide, South Australia.

Description. Snout short, pointed; rostral not projecting, visible dorsally to about one third the length of the frontonasal; nasals meeting at a point behind

the rostral; a small post-narial groove present. Frontonasal large, slightly wider than long; prefrontals small, in contact mesially by a distance equal to one third of the frontonasal length. Frontal 1¾ times as long as wide; slightly wider than the supraoculars and twice the maximum length of the frontoparietals which have a median suture equal to that of the prefrontals. Three supraoculars, the second largest and the first two in contact with the frontal; five supraciliaries, second largest. Interparietal large, smaller than the frontal, completely separating the parietals which are about twice as long as broad. Temporals 2 + 3, upper posterior large, elongate, twice as long as wide; lower anterior small, triangular; central posterior roughly rhomboidal; lower posterior small and rounded. Eight upper and eight lower labials, the fifth, sixth and seventh upper labials subocular; the seventh greatly enlarged. A complete series of infraoculars separate

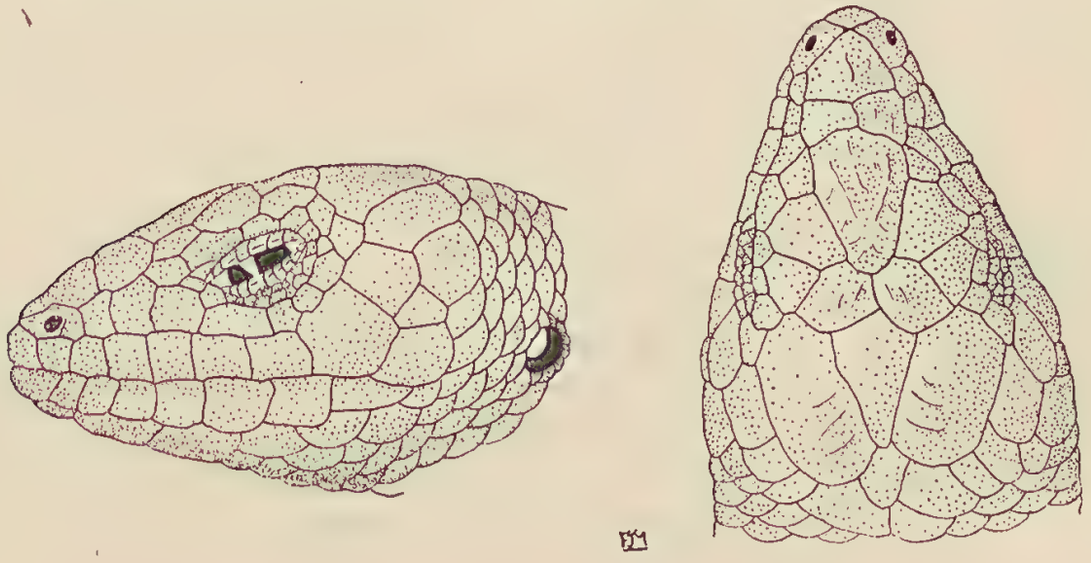


Fig. 8. *Tiliqua adelaidensis* (Peters): dorsal and lateral views of the head of the topotype.

the upper labials from the lower eyelid. A single pair of enlarged nuchals are separated from the interparietal by a small azygous scale; a pair of slightly enlarged anal plates present. Thirty-six smooth scales at midbody, rapidly increasing to forty-two or forty-four as the count nears the shoulder; ventrals largest. Tympanal opening oval, smaller than the eye opening; with one rounded lobule anteriorly. Fore and hind limbs of equal length and when adpressed along the body they fail to meet by a distance equal to their own length. The tail, which is shorter than the combined head and body measurement is strongly compressed and tapers rapidly to a fine point.

Colour (in spirit). General base colour grey-brown, lightening ventrolaterally to light blue-grey below. The dorsal and dorsolateral surfaces are broken

with an irregular mottling of darker spots and blotches. The limbs and tail have a rusty tinge. The ventral scales are dark edged giving the appearance of darker grey lines running between the series of scales. Ventral surface of tail and gular region nearly white.

Measurements. Total length, 138 mm.; tail length, 50 mm.; body length, 71 mm.; head length, 17 mm.; fore and hind limbs, 17 mm.

Loc. South Australia: R2227 (3 specimens), "Central South Australia"; R2228 (2 specimens) near Burra; R2229, Dry Creek (Adelaide).

VARIATION NOTED: Where more than one specimen is listed under one registration number the individuals are designated a, b, c, etc. in descending order of size. *Frontal*: In specimens R2227 a, b, c, and R2229 it is as wide as the interparietal while in R2228a and b it is narrower. In all specimens it is 1¼ to 1½ times as long as the interparietal. *Nasals*: They are separated by the frontonasal which forms a short median suture with the rostral in specimens R2227a, R2228a and b. In the other three specimens the nasals, frontonasal and rostral meet at a point. *Temporals*: The temporal counts vary as follows—R2227a, 2 + 3, 2 + 4: R2227b, 2 + 3, 1 + 3; R2227c, 2 + 3, 2 + 3; R2228a, 3 + 3, 3 + 3; R2228b, 2 + 3, 3 + 3; R2229, 2 + 3, 2 + 3. *Nuchals*: These vary from one pair in specimens R2227b, c, R2228 and R2229 to two pairs in R2227a and three pairs in 2228b. Except where separated by a small azygous scale as in R2229 and R2227c the first pair make contact with the interparietal. *Scale counts*: The midbody count varies from 34–38 and at the shoulder from 40–45. Owing to this irregularity it is essential that the body count be taken exactly at midbody.

Measurements. It is noticeable that the three "Central South Australian" specimens (R2227a, b, c) possess tails longer in relation to the total and body lengths. The total length—tail length ratios are as follows: R2227a, 139/58 mm.; R2227b, 123/53 mm.; R2227c, 121/48 mm.—R2228a, 123/44; R2228b, 94/36 mm. and R2229, 138/50 mm.

The scalation, although typical of the genus, does not suggest any immediate relationship and the lizard's strongly compressed tail and uniform sub-conically crowned teeth are not represented in any other species.

TILIQUA RUGOSA (Gray).

Trachysaurus rugosus Gray, 1827, p. 430.

Midbody scales 22–30; two or three supraoculars; interparietal completely dividing the parietals. A single pair of slightly enlarged nuchal scales are generally separated from the interparietal by an azygous occipital. Dorsal scales generally rugose, but sometimes smooth with an obtuse central keel. There is a

tendency for the parietal scales to become subdivided and in several of the specimens examined only the interparietal remains intact, the frontoparietals and parietals having been greatly subdivided.

The South Australian Museum collection contains two pairs of Siamese Twin lizards of this species. In both cases the two young are united at the head and shoulders.

Measurements of an average adult. 352 (265 + 87) mm.

Distribution. The drier parts of all mainland states. Type locality, King George Sound, Western Australia.

Loc. South Australia: R1396, R1397, Ooldea; R1802 (2 specimens), Minlaton; R258, Lucindale; R755, R756, Devil's Village; R1254, Tepko; R1256, Maitland; R1277 (3 specimens), Northern Flinders Ranges; R1393 (13 specimens), Victor Harbour; R2553, Spalding Cove; R2587, Port Pirie; R2801, Whittàta, also twelve specimens taken in and about the suburbs of Adelaide and several others without localized data. Western Australia: R1609; R229, R230, Warren River.

TILIQUA BRANCHIALE BRANCHIALE (Gunther).

Hinulla branchialis Gunther, 1867, p. 47.

Lygosoma (*Omolepida*) *branchiale* Boulenger 1887 p. 321 pl. xxvi fig. 2, Werner, 1910, p. 479.

Lygosomo melanops Stirling and Zietz 1893, p. 173, pl. vi, fig. 3.

Omolepida melanops Loveridge, 1934, p. 365.

Lygosoma gastrostigma Boulenger, 1893, p. 922, pl. lvii, fig. 2.

Tiliqua branchiale Smith, 1937, p. 233.

Loveridge (1934, p. 365) condemns the action of F. R. Zietz (1920, p. 214) in placing *Lygosoma melanops* Stirling and Zietz in the synonymy of *Lygosoma branchiale* Gunther. As he does not record having examined any specimens and was presumably working only on the published descriptions, I am inclined to consider that he was misled into formulating this criticism. I have re-examined the type specimens of *melanops* (R2732) and have compared them with thirteen additional specimens from South and Central Australia as well as seven from Western Australia and can find no valid structural differences, the only variation being in colouration as is indicated by the various published descriptions. Loveridge presumably examined the figure of Stirling and Zietz (1893, pl. vi, fig. 3a) which is inaccurate. It shows the frontoparietals fused, a condition which is not present in either of the types.

Loveridge (1934, p. 366) pointed out, when dealing with *O. casuarinae petersi* Sternfeld, that the number of supraoculars can often be alternatively translated, dependent on whether the last scale is accepted as a supraocular or an upper post-ocular. This is applicable in the present case, the number having been alternatively translated as three (*melanops* and *woodjonesii*) or four (*branchiale* and *gastrostigma*). The colour variation does not appear to be correlated in any way with the other variable features, viz. the relative size of the ear opening, body proportions and distribution. The tip of the snout to fore-limb into axilla-groin proportion has been found essentially an age/sex character and of no systematic value (see also Loveridge, 1948, p. 309). Midbody scales in 24 rows (2 specimens); 26 rows (17 specimens).

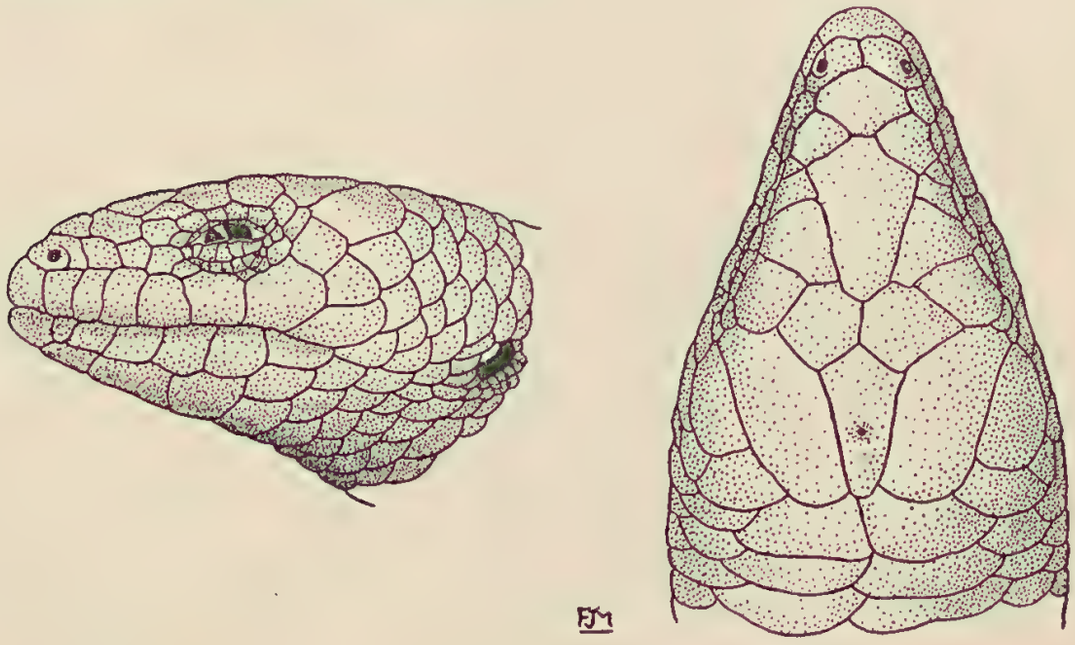


Fig. 10. *Tiliqua branchiale branchiale* (Gunther): dorsal and lateral views of the head of the holotype of *Omolepida melanops* Stirling and Zietz.

Measurements of an average adult. 160 (85 + 75) mm.

Distribution. Western Australia, South Australia and the Northern Territory. Type locality, Champion Bay, Western Australia.

Loc. South Australia: R2730, Kangaroo Island; R2731, Barton; R2732 (2 specimens), between Everard and Barrow Ranges (Types of *L. melanops* S. and Z.); R2733, Pt. Augusta; R2734, between Ooldea and Talarinna. Northern Territory: R2735, Hermannsburg. Western Australia: W.A.M. R416, R444, Perth; W.A.M. R1724, R1725, R1726, R1727, Newmarracarra, 19 miles east of Geraldton; W.A.M. R4783, North Beach, near Perth.

TILIQUA BRANCHIALE WOOD-JONESII (Proctor).

Lygosoma (*Homolepida*) *woodjonesii* Proctor, 1923, p. 80.

This insular race differs from its nominate form in possessing 28 instead of 24–26 midbody scales and in several other minor scalation details. Of the eight St. Francis Island specimens examined seven possessed 28 midbody scale rows and one 26, although in this latter specimen 28 could be counted at a point forward of midbody. The colouration is uniform dark grey dorsally, each scale edged with black; lighter ventrally.

Loc. South Australia: R1198, R2728 (3 specimens), R2729 (4 specimens), St. Francis Island.

TILIQUA CASUARINAE CASUARINAE (Dumeril and Bibron).

Cyclodus casuarinae Dumeril and Bibron, 1839, p. 749.

Midbody scales in 22–24 rows; three supraoculars. Prefrontals separated or forming a short median suture; nasals meeting at a point behind the rostral.

Measurements of an average adult. 276 (149 + 127) mm. tail reproduced.

Distribution. Tasmania, Victoria and coastal parts of Southern New South Wales. Type locality, Australia (not localized).

Loc. Tasmania: R2231 (6 specimens), unlocalized.

TILIQUA CASUARINAE PETERSI (Sternfeld).

Lygosoma (*Lygosoma*) *mulleri* Peters (*non.* Schlegel), 1878, p. 181.
Lygosoma (*Homolepida*) *petersi* Sternfeld, 1919, p. 81.

Midbody scales in 24 rows; three supraoculars; prefrontals forming a median suture, nasals meeting at a point behind the rostral.

This subspecies appears to have been formed on slender grounds, the only evident differences from the nominate race being the more uniform colouration and the greater development of the auricular lobules, both of these are weak characters and must be subject to considerable variation.

Distribution. South and Central Australia. Type locality, Hermannsburg Mission, Northern Territory.

Loc. South Australia: R59 (3 specimens), unlocalized.

SUMMARY.

A synopsis of the salient features and variation shown by species of the genera *Egernia* and *Tiliqua* is based on a series of approximately 475 specimens contained in the collections of the South Australian, Western Australian and Queensland Museums.

It is submitted that there are grounds sufficient to warrant the following taxonomic changes.

Osteological and dental characters are used as supporting evidence for the following generic reshuffle:

Trachysaurus Gray (1827) and *Hemisphaeriodon* Peters (1867) = *Tiliqua* Gray (1825).

Egernia luctuosa (Peters) is transferred to the genus *Tiliqua.*

Dermal characters are used to support the following specific changes:

Lygosoma melanops Stirling and Zietz = *Tiliqua branchiale branchiale* (Gunther.

Egernia whitei tenebrosa Condon = *Egernia whitei whitei* (Lacepede).

Egernia whitei carnarae Kinghorn and *Lygosoma (Hinulia) breviunguis* Kinghorn = *Lygosoma (Sphenomorphus) ocelliferum* Boulenger.

? *Egernia lohmanni* Werner = *Egernia cunninghami* (Gray).

Egernia dahlii Boulenger = *Egernia kintorei* Stirling and Zietz.

Egernia rugosa De Vis = *Egernia dorsalis* (Peters).

Egernia lauta De Vis = *Tiliqua luctuosa* (Peters).

Egernia carinata Smith = *Egernia striolata nitida* (Gray).

The following are regarded as subspecies:

Egernia bungana De Vis is placed as a race of *Egernia major* (Gray).

Lygosoma (Homolepida) woodjonesii Proctor is placed as a race of *Tiliqua branchiale* (Gunther).

Egernia napoleonis (Gray) is placed as a race of *Egernia whitei* (Lacepede).

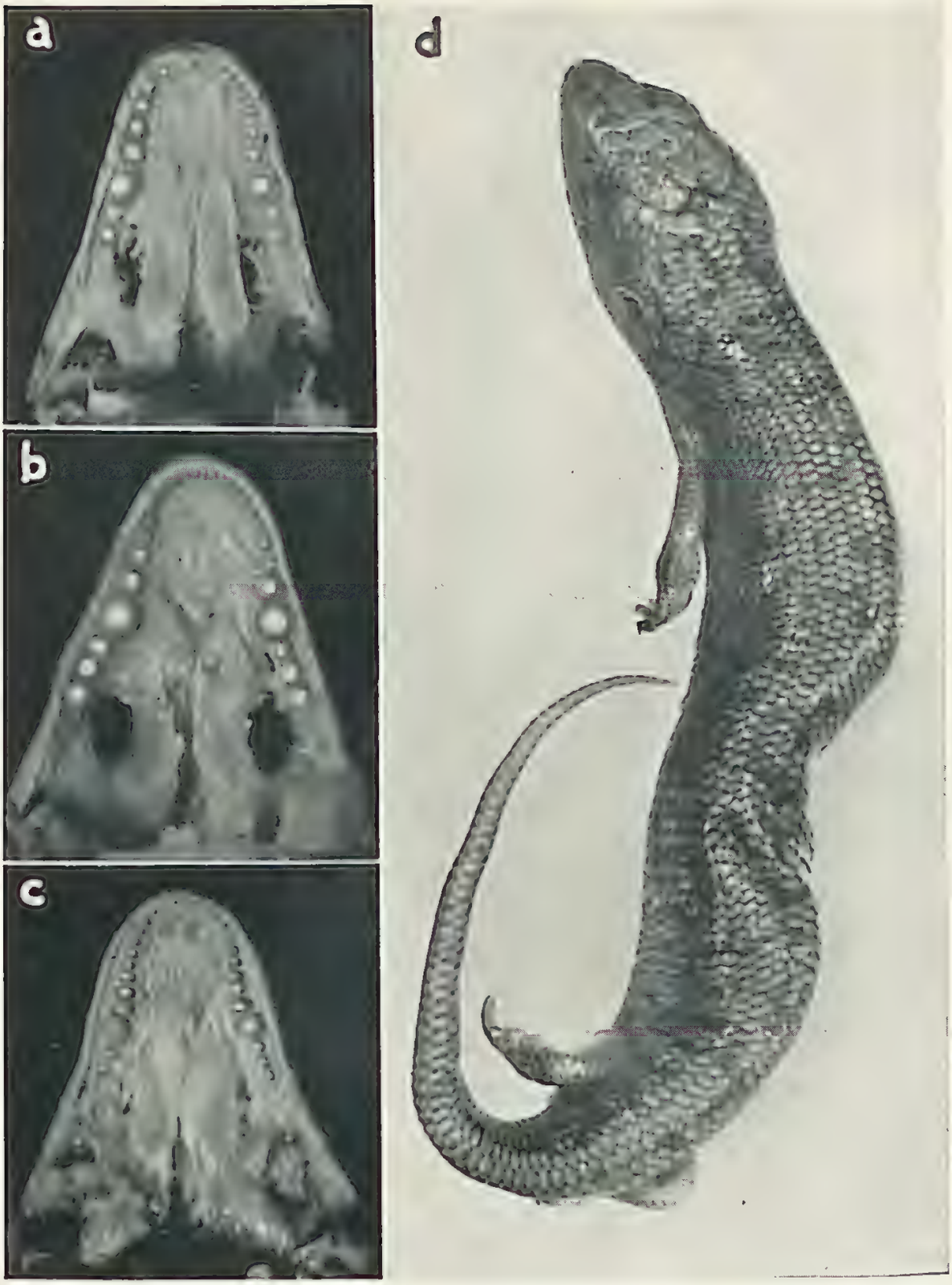
Egernia nitida (Gray) is placed as a race of *Egernia striolata* (Peters).

A lectotype of the poorly described *Egernia kintorei* Stirling and Zietz and a topotype of the little known *Tiliqua adelaidensis* (Peters) are fully described. A dichotomic key has been constructed for each of the two genera recognised and figures are given of species previously not adequately illustrated.

REFERENCES CITED.

Boulenger, G. A. (1887) : British Museum Catalogue of Lizards, 2nd Ed., iii, pp. 134–149 (London).
Boulenger, G. A. (1896) : *Ann. & Mag. Nat. Hist.* (6), xviii, p. 233.
Boulenger, G. A. (1898) : *Proc. Roy. Zool. Soc.*, p. 922, pl. lvii, fig. 2.
Condon, H. (1941) : *Rec. S. Aust. Mus.*, vii, p. 211, fig. 1.
De Vis, C. W. (1887) : *Proc. Linn. Soc. N. S. Wales*, (2), ii, pp. 813–816.
De Rooij, N. (1915) : Indo-Australian Reptiles, i, p. 158 (Leiden).
Dumeril, A. and Bibron, G. (1839) : Erpet. Gen., v, p. 749.
Dumeril, A. (1851) : Cat. Method. Rept., p. 23.
Fitzinger, L. J. E. R. (1843) : Syst. Rept., p. 23.
Fry, D. B. (1914) : *Rec. W. Aust. Mus.*, (1), iii, p. 184.
Gray, J. E. (1825) : *Ann. Phil.* (2), x, p. 201.
Gray, J. E. (1827) : King's Voy. Aust., ii, p. 430.
Gray, J. E. (1831) : Griffith's Cuvier Animal King., 9, Syn., p. 68.
Gray, J. E. (1832) : *Proc. Roy. Zool. Soc.*, p. 40.
Gray, J. E. (1839) : *Ann. & Mag. Nat. Hist.*, ii, p. 288.
Gray, J. E. (1845) : Brit. Mus. Cat. Liz. (London).
Gunther, A. (1867) : *Ann. & Mag. Nat. Hist.* (3), xx, p. 48.
Gunther, A. (1875) : *Zool. Erebus & Terror, Rept.*, p. 15.
Gunther, A. (1897) : *Nov. Zool.*, iv, p. 405.
Kinghorn, J. R. (1931) : *Rec. Aust. Mus.*, xviii, p. 88.
Kinghorn, J. R. (1932) : *Rec. Aust. Mus.*, xviii, p. 301, fig. 1.
Lacepede (1804) : *Ann. Mus. Paris*, iv, p. 192.
Longman, H. (1918) : *Mem. Qld. Mus.*, vi, p. 37, pl. xiii.
Loveridge, A. (1934) : *Bull. Mus. Comp. Zool.*, lxxvii, (6), pp. 336–344.
Loveridge, A. (1938) : *Trans. Roy. Soc. S. Aust.*, (2), 62, p. 187.
Loveridge, A. (1948) : *Bull. Mus. Comp. Zool.*, ci, No. 2, p. 339.
Lucas, A. H. S. and Frost, C. (1893) : *Proc. Linn. Soc. N. S. Wales*, (2), viii, p. 227.
Macleay, W. (1885) : *Proc. Linn. Soc. N. S. Wales*, x, p. 65.
McCoy, F. (1890) : *Prod. Zool. Vict.*, ii, p. 329, pl. cxci, fig. 1.
Mitchell, F. J. and Behrndt, A. C. (1949) : *Rec. S. Aust. Mus.*, ix, p. 176, fig. 2.
Peters, W. (1863) : *Mon. Akad. Berlin*, p. 232.
Peters, W. (1866) : *Mon. Akad. Berlin*, p. 90.
Peters, W. (1867) : *Mon. Akad. Berlin*, p. 24.
Peters, W. (1870) : *Mon. Akad. Berlin*, p. 642.
Peters, W. (1873) *Mon. Akad. Berlin*, p. 743.
Peters, W. (1878) : *Sitzber. Ges. Naturf. Freunde*, Berlin, p. 191.

Proctor, J. B. (1923) : *Trans. Roy. Soc. S. Aust.*, xxxxvii, p. 80.
Rosen, N. (1905) : *Ann. & Mag. Nat. Hist.*, (7), xvi, p. 139, fig. 3.
Schneider, J. G. (1801) : *Hist. Amph.*, ii, p. 202.
Shaw, G. (1790) : in White's Journ. N. S. Wales, p. 242, pl.
Smith, A. (1835) : *S. African Quart. Journ.*, ii, p. 144.
Smith, M. A. (1937) : *Rec. Indian Mus.*, xxxix, p. 232.
Smith, H. M. (1939) : *Field Mus. Pub. Zool.*, Chicago, xxiv, pp. 11–14, fig.
Sternfeld, R. (1919) : *Mitt. Senckenb. Naturf. Gesell., i,* p. 79.
Stirling, E. C. and Zietz, A. (1893) : *Trans. Roy. Soc. S. Aust.*, xvi, pp. 171–173, pl. vi, fig. 3.
Strauch, A. (1866) : *Bull. Ac. St. Petersb.*, x, p. 458.
Wagler, J. (1828) : *Desc. Icon. Amphib.*, i, tab. 6.
Wagler, J. (1830) : *Syst. Amphib.*, p. 162.
Waite. E. R. (1929) : Rept. & Amphib. of South Australia, pp. 142–146 (Adelaide).
Werner, F. (1909) : *Mitt. Nat. Hist. Mus. Hamburg,* p. 42.
Werner, F. (1910) : Fauna Sudwest Aust., ii, p. 479 (Jena).
Werner, F. (1917) : *Mitt. aus dem Zoologischen Museum,* xxxiv, p. 32.
Zietz, F. R. (1920) : *Rec. S. Aust. Mus.*, i, pp. 181–228.



a. Palate and dentition of *Tiliqua gerrardii*. b. Palate and dentition of *Tiliqua scincoides aygas* (Juvenile). c. Palate and dentition of *Tiliqua casuarinae*. d. Topotype specimen of *Tiliqua adelaidensis*.

Photography by C. Norton.

A RECONSTRUCTION OF THE KANGAROO ISLAND EMU *(DROMAIUS DIEMENIANUS)*

By PAUL F. LAWSON, South Australian Museum.

Plates xxiv–xxv and Text Fig. 1–10.

Following a suggestion from the Board of Governors of the South Australian Museum, the writer attempted a reconstruction of the extinct emu from Kangaroo Island, South Australia, as it appeared in life. This paper describes the methods used in the preparation of the specimen and does not draw comparisons from an ornithological viewpoint; these have been dealt with adequately by Morgan and Sutton (1927–28).

The only feathered specimen of *Dromaius diemenianus* known to be preserved is in the Museum National d'Histoire Naturelle, Paris; this was mounted many years ago. Skeletal material housed in the South Australian Museum is sufficient to gain a knowledge of the general proportions of the Kangaroo Island bird, but details of the type and texture of the feathers are known only from the unique Paris specimen; we are indebted to the Director of the Muséum National d'Histoire Naturelle for photographs of this example. They suggest that the feathers of *Dromaius diemenianus* are relatively wider than in the mainland *Dromaius novae-hollandiae*; it should be noted that feathers of *Dromaius novae-hollandiae* were used for the reconstruction. The form and size of the model were based on a complete skeleton in the South Australian Museum (Reg. No. B6814).

In beginning the reconstruction a full-sized drawing of the bones in their relative positions was made; with this as a guide, leg-irons three-eighths of an inch in diameter were bent and threaded, and a centre board of seven-eighths of an inch pine was cut to outline the body. A three dimensional metal template of the skull (fig. 1–2) attached to a piece of three-quarters by one-eighth inch mild steel constituted the neck assembly. This was screwed to the top of the centre board, and was easily detachable during subsequent moulding and casting operations.

The head and neck were modelled in plasticine (fig. 3) over the metal template; glass eyes were placed in position in order to ensure subsequently accurate fitting in the plastic reproduction. Plasticine also served for modelling the feet and legs, the scales being made to conform as closely as possible in number to the Paris specimen.

Next, using the ribs as a pattern, wooden forms were cut on a band saw and screwed to the centre board; the leg irons were bolted to metal brackets to act as the pelvic assembly. Although the original bones were used in the laying out of the drawing and for frequent measurement checks, the valuable skeletal material was not used in the construction of the manikin.

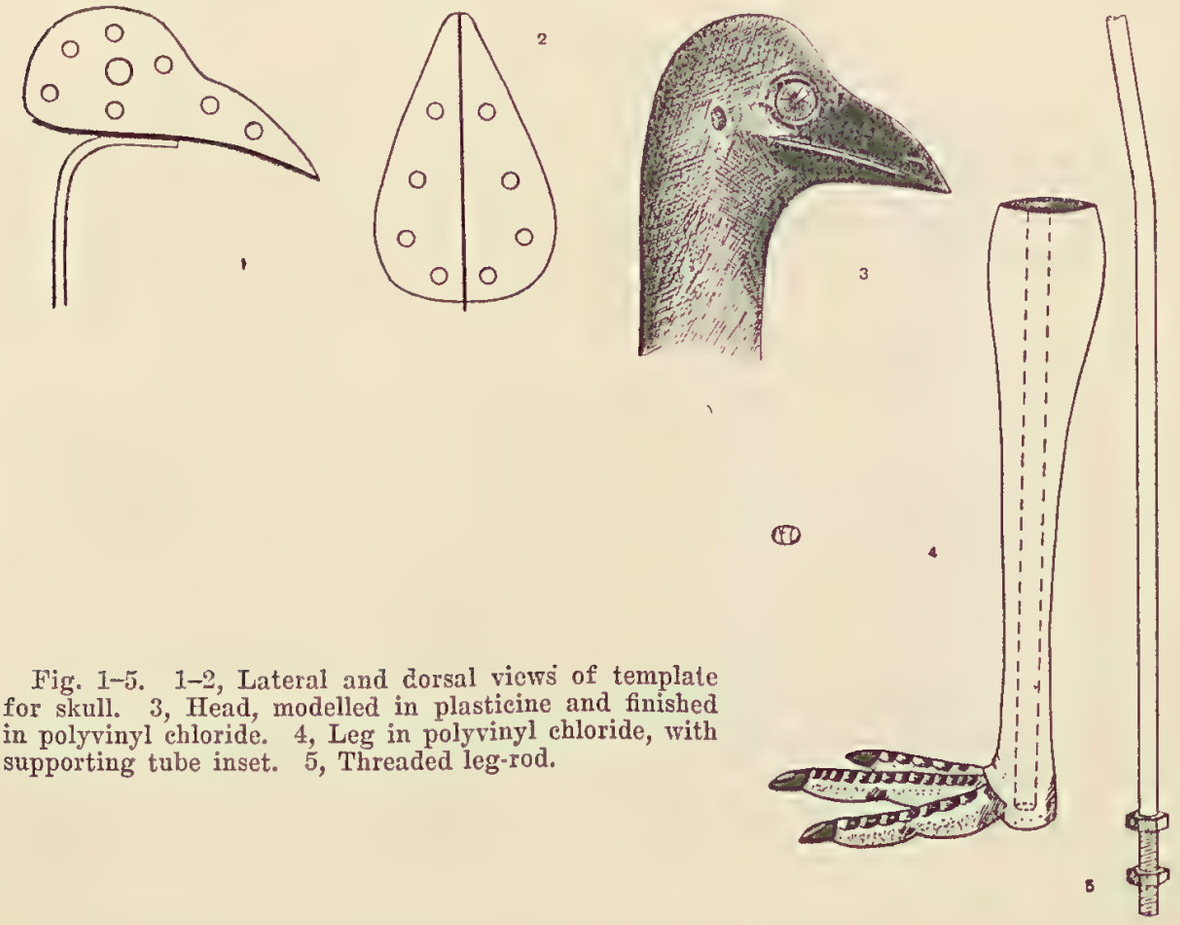


Fig. 1–5. 1–2, Lateral and dorsal views of template for skull. 3, Head, modelled in plasticine and finished in polyvinyl chloride. 4, Leg in polyvinyl chloride, with supporting tube inset. 5, Threaded leg-rod.

Fig. 6 shows the framework before the material representing muscular tissue was applied; this consisted of wood-wool (or "excelsior") laced on and covered with hessian (burlap) and plaster, to serve as a base for the final modelling in clay of muscular detail.

The next step was the moulding of the model. The head and neck assembly was detached for separate moulding; the exposed portions of the legs were not attached to the body and so presented no difficulties in moulding. The body mould was prepared in three pieces (fig. 7–8) using clay walls to demarcate sections; plaster reinforced with burlap was used for this portion of the work. The head was moulded in two pieces (fig. 9) using "Greenstone" plaster. Each leg mould consisted of two elongate pieces, plus a third piece for the sole of the foot; again "Greenstone" plaster was used.

Polyvinyl chloride was employed in reproducing the head and legs as casts. As this is normally a soft material, an internal support was made for the legs, allowing the last-named to slide over the three-eighths of an inch leg irons attached to the body. This was accomplished by the use of seamless steel tubing with an internal diameter large enough to slide over the rods. After the steel tubes were placed in the leg mould the latter was filled with Polyvinyl chloride and then cured; Fig 4 is a diagrammatic sketch of the leg with the steel tube in place preparatory to the insertion in it of the leg rod (Fig. 5).

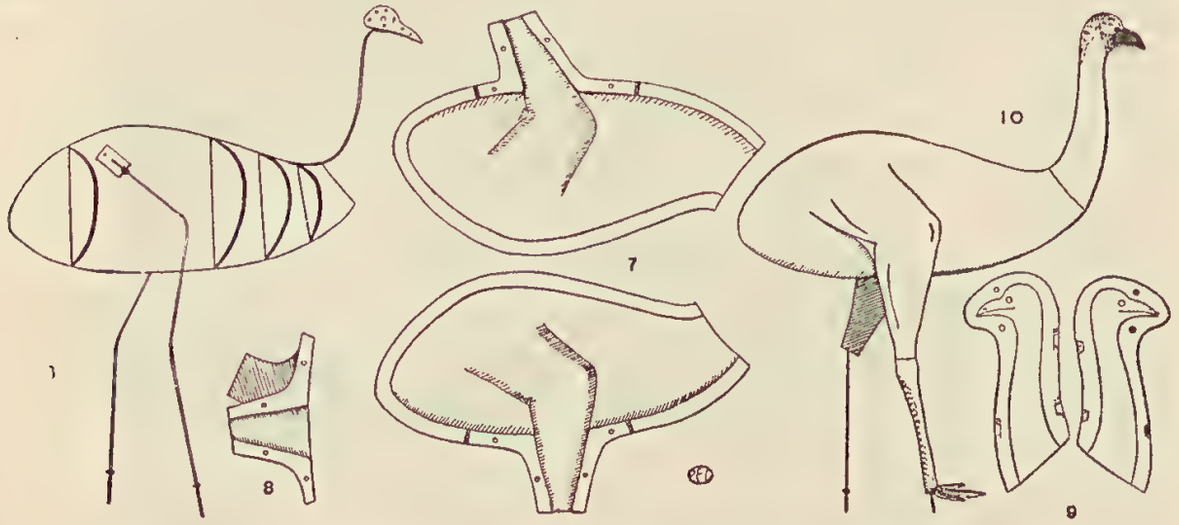


Fig. 6–10. 6, Armature of body ready to receive woodwool. 7, Two halves of the plaster body mould. 8, Ventral section of body mould including inner halves of legs. 9, Mould of head and neck. 10, Completed manikin, without one of the plastic legs (added by removing the nut on the leg iron, slipping on the leg, and replacing the nut).

The high curing temperature of Polyvinyl chloride (160° C.) necessitated the use of "Greenstone" plaster because of its better heat resisting properties.

The glass eyes were removed from the plasticine model of the head and neck; "Greenstone" plaster replicas made from the eyes were then fastened to the mould with celluloid cement in their correct positions. The head was reproduced in Polyvinyl chloride by the flow casting method, which resulted in a hollow replica; the cavity of the last-named was then filled with plaster, using the original three-quarter inch by one-eighth inch neck iron as reinforcement, and as a means of firmly attaching the neck to the body. When the mould was removed the plaster eyes were readily detached and were replaced by the glass ones.

The body was reproduced in papier maché using strips of soft paper and flour paste, backed with heavier paper.

After drying and removal from the mould the three body sections were trimmed and assembled over the centre board and leg irons, cemented together

and finally completely coated with glue and whiting paste; this last operation rendered the body rigid and strong. The manikin (fig. 10) was completed by fixing the head and feet to the body.

According to literature, the plumage of *Dromaius diemenianus* was somewhat darker in colour than is usual in *Dromaius novae-hollandiae*; therefore, a blackish bird was collected by the writer from the Cooks Plains area in South Australia. The skin of this specimen, after trimming and cutting was attached to the body with paste, nails being used to hold the skin while it dried. The skin was extended on the head only as far as the mandibles; the horn-like mandible was represented by the suitably painted plastic, and the same treatment was accorded to the feet and legs up to the line of the leg feathers.

Plate xxiv shows three views of the completed reconstruction and Plate xxv shows close-up views of the head and feet.

SUMMARY.

An attempt has been made to reconstruct the extinct Kangaroo Island Emu (*Dromaius diemenianus*). The proportions are based upon a skeleton (Reg. No. B6814, South Australian Museum) and the plumage gives the approximate appearance of the bird during life.

ACKNOWLEDGMENTS.

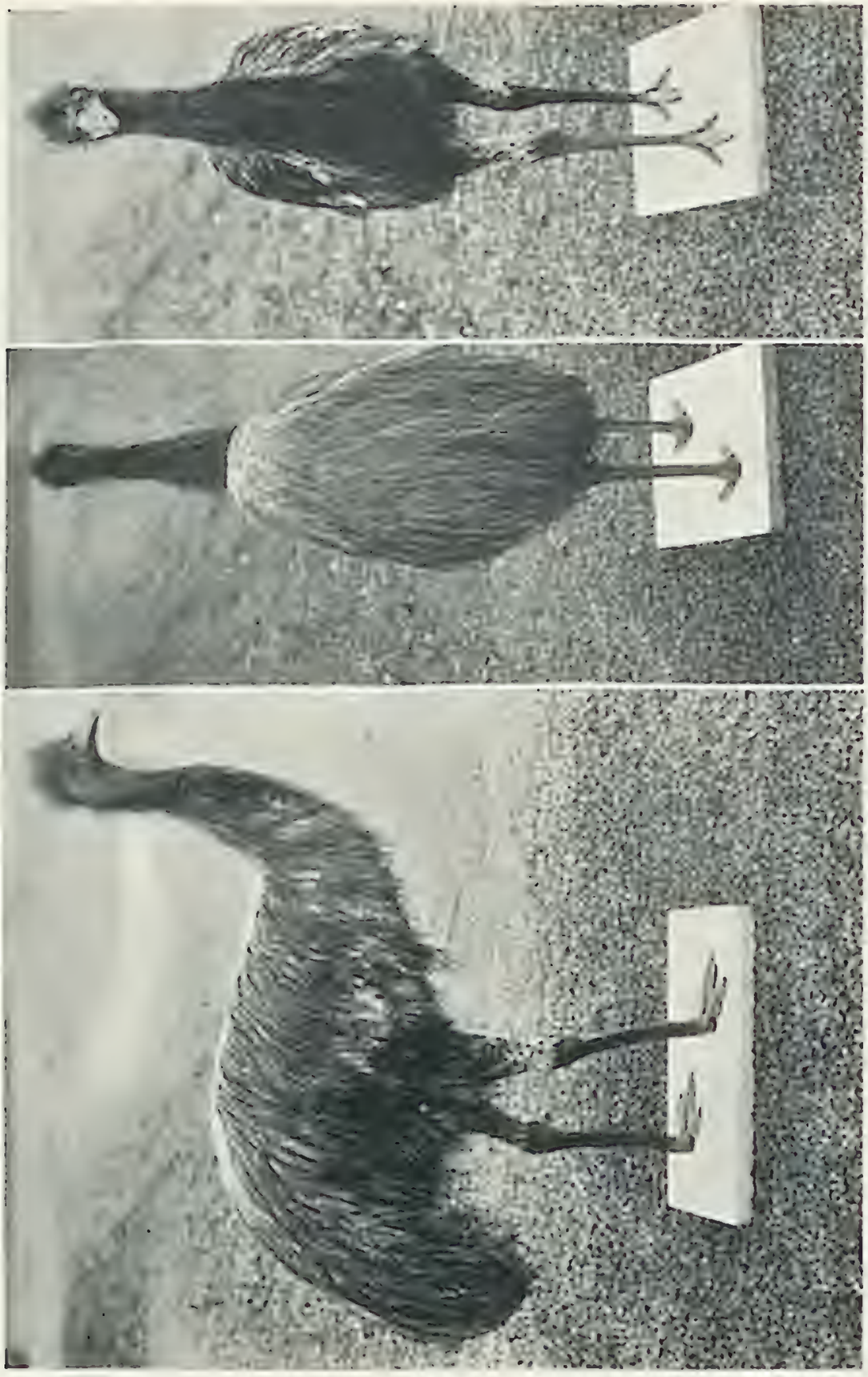
I wish to thank Sir James Gosse, at whose instigation this reconstruction was attempted, and the Museum Director (Mr. H. M. Hale) for his co-operation on the project; also the Director of the Museum National d'Histoire Naturelle, Paris, for the photographs of the only mounted specimen extant.

BIBLIOGRAPHY.

Lawson, Paul F. (1948): "A Reconstruction of the Kangaroo Island Emu." *News Bulletin of the Art Galleries and Museums Association of Australia* and *New Zealand,* pp. 13–14.

Lawson, Paul F. (1949): "Plastics in the Museum." *News Bulletin of the Art Galleries and Museums Association of Australia and New Zealand,* pp. 13, 14, 15.

Morgan, A. M. and Sutton, J. (1928): "A Critical Description of Some Recently Discovered Bones of the Extinct Kangaroo Island Emu, *Dromaius diemenianus.*" *The Emu,* vol. 28, pp. 1–19.



Three views of reconstruction of *Dromaius diemenianus*.

Photographs showing details of head, and scalation of feet and legs, of reconstruction of *Dromaius diemenianus*.

The STILT-BUGS *(HETEROPTERA-NEIDIDAE)* of the AUSTRALIAN and NEW ZEALAND REGIONS

By GORDON FLINDERS GROSS, B.Sc., South Australian Museum.

Fig. 1–4.

INTRODUCTION.

The material described in this paper is in the collections of the South Australian Museum, Adelaide, the Australian Museum, Sydney, and the British Museum (Natural History), London.

I am especially indebted to Dr. W. E. China of the British Museum for arranging exchange of comparative material, and for observations and information on various aspects of synonomy, in particular for his opinion that *Metatropis tipularius* Dist. is synonymous with *Capyella lobulata* Bergroth.

Family NEIDIDAE Kirkaldy 1902.

Species slender and delicate with very long legs and antennae. Apex of first segment of the antennae, and apices of the femora, clavate; terminal segment of antennae enlarged and fusiform; antennae four-segmented and tarsi three-segmented. Head usually equipped with a transverse dorsal sulcus immediately anterior to ocelli, and continued laterally to the hind margin of the eyes. Pronotum dorsally and laterally, and the subcoxae covered with a raised net-like reticulation enclosing polygonal pits or punctuations.

Of the six species which have been recorded from this area, the two Australian species are synonymous. Four species from Australia are herein described as new, while two others, originally described from India, are now shown to occur in the Australasian region, making the total number of species eleven.

These insects are rare, and appear to frequent vegetation near water, where the best method of capture is by sweeping. Most species are to be found in high rainfall areas, though *Protacanthus halei* sp. nov. seems capable of living under semiarid conditions.

Key to Australian and New Zealand Genera.

1. Scutellum unarmed, or provided with a simple keel or obtusely pointed nodule; head with a prominent "horn" located between the bases of the antennae and which may project forward horizontally to or past the tylus 2
   Scutellum armed with a long suberect spine, which curves backward somewhat; head unarmed 3

2. Anterior pronotal margin concave. Australian and New Zealand species dimorphic in both hemielytra and wings, brachypterous form commonest .. .. *Neides* Latreille 1804.
Anterior pronotal margin convex, dimorphism does not occur.
.. .. *Capyella* Breddin 1907.

3. Odoriferous apertures provided with a process, which projects up above the level of the hemielytra; no anterior processes to the pronotum .. 4
Process of the odoriferous apertures not well developed or unduly produced; pronotum equipped with a spine near each antero-lateral angle
.. .. *Protacanthus* Uhler 1893.

4. Pronotum equipped with three prominent tubercles posteriorly
.. .. *Gampsocoris* Fuss 1852.
Pronotum equipped with three obsolete tumescences posteriorly .. 5

5. Corium and clavus impunctate .. .. *Metacanthus* Costa 1848.
Corium impunctate, clavus punctate .. .. *Pneustocerus* Horvath 1905.

Genus NEIDES Latreille 1802.

Neides Latreille 1802, Hist. Nat. Crust. Ins. III, p. 246. Logotype *N. tipularius* (Linn) designated by Westwood 1840. A palaearctic species.

In addition to the synonomy cited by Van Duzee, 1917, Cat. Hem. Am. Nth. of Mexico, pp. 143–144, there are the following references: Douglas and Scott 1865, Brit. Hem. I, p. 160; Saunders 1892, Hem. Heterop. Brit. Is., p. 61; Hedicke 1932, *Mitt. deuts. ent. Ges. 3,* p. 134.

Vertex of head equipped with a horn-like process; the basal segment of the rostrum does not reach the anterior ventral margin of the pronotum; second segment of antennae longer than the fourth. Anterior margin of the pronotum concave; posterior two-thirds of the pronotum convexly raised in the macropterous form, but flat and coplanar with anterior third in the brachypterous; both pronotum and abdomen unarmed. Scutellum furnished with an obtusely pointed nodule, and the process associated with the odoriferous apertures not well developed, or unduly prolonged.

In addition, the following tendent characters occur; the horn-like process of the vertex tends to project forward horizontally over the tylus, and in the European species to be equipped with a ventrally directed (and placed) semicircular lamina, but in *Neides tasmaniensis,* the horn is very reduced, and inclined at an angle of 45° (fig. 1b); the eyes tend to lie midway between the anterior apex of the horn, and the anterior margin of the pronotum, but this is not so in *N. tasmaniensis* due to the reduction of the horn, or in *N. maiponga* due to an elongation of the postocellary portion of the head; the first segment of the rostrum tends to reach only to about the region of the anteocellary

sulcus, but reaches nearly to the anterior margin of the pronotum in *N. tasmaniensis*, and the rostrum itself tends to reach only to the mid-coxae, but in *N. tasmaniensis* surpasses the mid-coxae.

Pterygopolymorphism is common and of two distinct types; in the European species, the hemielytra are always longer than the abdomen, and never reduced in the brachypterous form; in the Australian and New Zealand species, the hemielytra and wings in the macropterous condition never reach much beyond the middle of the abdomen (fig. 2 a), while in the brachypterous form, both hemielytra and wings are considerably reduced (figs. 1 a, 2 c), and the membrane of the hemielytra is no more than a vestigial flap. Myers (1926) first recorded this second type of dimorphism for *N. wakefieldi* Buch. White, and I have specimens in both conditions of *N. maiponga*, among which the brachypterous condition predominates; the only three specimens of *N. tasmaniensis* I have seen are brachypterous, though doubtless the macropterous form does exist. This evidence supports Myer's statement that apparently brachyptery is the normal condition.

The genus is cosmopolitan and three species, two of them new, are shown to occur in the Australian and New Zealand regions.

KEY TO SPECIES OF *NEIDES*.

1. Hemielytra never shortened, always extending past the apex of the abdomen, wings may be shortened .... European species.
   Hemielytra and wings commonly shortened, but when fully developed, not extending much beyond the middle of the abdomen .... Australian and New Zealand species.

2. Cephalic horn strongly developed, projecting forward horizontally over the tylus; rostrum reaching mid-coxae 3
   Cephalic horn very reduced and set at an angle of 45°; rostrum reaching hind coxae .. .. *N. tasmaniensis* sp. nov.

3. Body thickly pilose above and below; eyes approximately midway between anterior margin of pronotum and apex of horn .. *N. wakefieldi* Buch. White.
   Body weakly pilose above and below; eyes much nearer to apex of cephalic horn than to anterior margin of pronotum .. .. *N. maiponga* sp nov.

NEIDES TASMANIENSIS sp. nov.

Fig. 1, a–b.

Colouration: testaceous; underside of head, last segment of antennae, distal half of last segment of rostrum, distal ends of tibiae, tarsi and ventral sulcus of thorax black; femora (except distal testaceous clubs), tibiae and first three

antennal segments (except distal clubs of first, which are concolourous with femoral clubs), transverse fascia on upper surface of the abdominal connexivia, and a central ventral abdominal fascia yellowish.

Structure: eyes somewhat nearer tylus than to fore margin of pronotum; spine of vertex very reduced, and set at an angle of 45°; there is no process on the tylus; rostrum surpasses the mid-coxae, first segment not quite

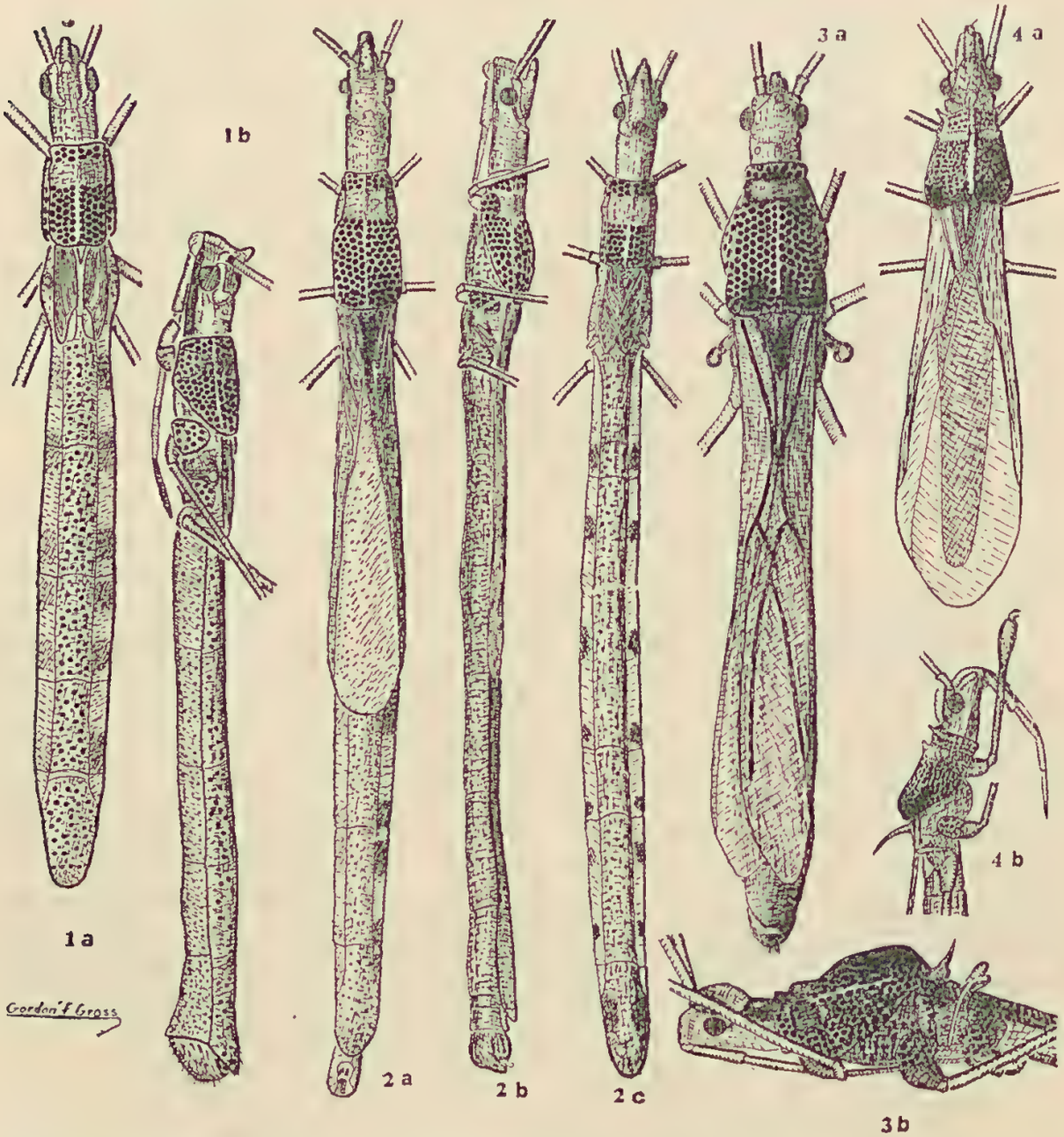


Fig. 1. *Neides tasmaniensis*; a–b, dorsal and lateral views of brachypterous male.
Fig. 2. *Neides maiponga*; a–b, dorsal and lateral views macropterous male, c dorsal view brachypterous male.
Fig. 3. *Metacanthus pluto*; a–b, dorsal and lateral views male.
Fig. 4. *Protacanthus halei*; a–b, dorsal and lateral views female.

reaching the anterior margin of prothorax, ratio of segments 9:9; 7·5:7·5. Abdomen above and below, coarsely punctate.

Length 6·5–7·5 mm. Width 0·5 mm.

Habitat. Tasmania: Hobart, 22.1.16, C. Cole; Launceston, 6 Sept., 1929, V. V. Hickman, "Under log". N. S. Wales: A. M. Lea.

Types: Holotype and paratype in collection of South Australian Museum (No. I.20025), allotype (No. K60373) in collection of Australian Museum.

NEIDES WAKEFIELDI Buch. White 1878.

Neides wakefieldi Buchanan White 1878, *Ent. Mon. Mag.* 15, p. 31; Hutton 1897, *Trans. N.Z. Inst.* xxx, p. 172; Myers 1926, *Trans. N.Z. Inst.* 56, p. 485–6; Tillyard 1926, Ins. Aus. N.Z., pp. 147–8, fig. Q5.

Colouration: testaceous; the side of the head and of the prostethium with a longitudinal brown line.

Structure: the apical lamina (spine of vertex) of the head cylindrical, straight, gradually narrowed to an obtuse point, and reaching far beyond the apex of the head, anteocular part of the head subequal to the postocular.

In addition, the body is covered with a long, whitish pubescence which readily distinguishes it from *N. tasmaniensis* and *N. maiponga*, in which only a very sparse pubescence is present.

Length 7–8 mm. Width 1 mm.

Habitat. New Zealand: "Wellington, Wanganui, Canterbury, rare in the North Island, taken in December and April" (Myers).

NEIDES MAIPONGA sp. nov.

Fig. 2, a, b, c.

Colouration: testaceous; pronotum, spine on vertex of head, femora (a broad brown band on the apical clubs excepted), tibiae (apices excepted), first three segments of antennae (a broad brown band on apical club of the first excepted) a basal and a distal band on the fourth segment, a dorsal longitudinal line on head from between ocelli to anterior margin of pronotum, tylus and some contiguous areas of jugae, insertions of antennae and some transverse fasciae on the upper surface of abdominal connexivia yellowish. Other transverse fasciae on connexivia, and a broad median band on last segment of antennae blackish brown. Eyes in life red.

Structure: Spine of vertex sparsely pilose and projecting forward to tylus; last segment of antennae elongately fusiform; rostrum reaching the intermediate coxae, first segment reaching to about anteocellary sulcus. Hemielytra

in macropterous form extending half-way down the length of the abdomen, but in the brachypterous form extending only one-ninth the length of the abdomen.

Length 10·8 mm. Width 0·5 mm.

Habitat. South Australia: Myponga, from small swamp, G. F. Gross; Adelaide, 10th March, 1949, F. J. Mitchell; Cape Jervis area, from *Acacia* in creek, 27th February, 1949, G. F. Gross. Tasmania: New Norfolk, in tussock, A. M. Lea.

Types. Holotype (macropterous), allotype (macropterous), 1 paratype (macropterous), and 3 paratypes, 2 ♂, 1 ♀ (brachypterous), in the collection of the South Australian Museum (No. I.20026), 2 paratypes (brachypterous) in the British Museum, and 1 paratype (brachypterous) in the Australian Museum.

Genus CAPYELLA Breddin 1907.

Capyella Breddin 1907, *Deuts. Ent. Zeit.*, p. 36 (Haplotype *malacaipus* (Stal) an African and Indian species). Bergroth 1909, *Ann. Soc. Ent. Belg.* 53, p. 188–9.

Capys Stal 1865, *Hem. Afr.* 11, p. 119; Stal. 1874, Enum Hem IV, p. 128; Lethierry and Severin 1894, Cat. Hem. II, p. 131. Distant 1908, Faun. Brit. Ind. Rhynch, IV, p. 489 (pre-occupied by *Capys* Hewitson 1865, Lepidoptera).

Capytum Strand 1926, *Arch. Naturg.* 92, A8, p. 47.

Head armed with porrect spiniform process, pronotum posteriorly depressed and furnished with an obtuse conical tubercle near each lateral angle, mesosternum, metasternum and first abdominal segment sulcated, process of the odoriferous apertures apically emarginate (abbreviated from Stal).

In addition, the second segment of the antennae is longer than the fourth; the anterior margin of the pronotum is sinuately convex, and the pronotum and the abdomen are unarmed; the scutellum is furnished with a short obtusely pointed spine.

This genus is known from the African, Indian and Australian regions; there is one Australian species.

CAPYELLA LOBULATA Bergroth 1909.

Capyella lobulata Bergroth 1909, *Ann. Soc. Ent. Belg.*, 53, 188.

Metatropis tipularius Distant 1911, *Ann. Mag. Nat. Hist.* (18), 7, (42), 585.

Colouration: testaceous; abdomen beneath pale yellow, with a marginal series of ochraceous spots; fourth segment of the antennae black with a white subbasal annulation.

Structure: the rostrum reaches the intermediate coxae, first segment subequal to the second and third together, basal margin of the pronotum produced into a rounded lobe above the base of each corium.

Length 8–9 mm. Width 1 mm.

Differs from *C. malacaipus* (Stal) (= *horni* Breddin) and *C. gracilis* (Dist.), in the short rostrum which reaches only to the intermediate coxae, and in the light underside of the abdomen.

Habitat. Northern Territory, Australia.

Types. Unique types of *C. lobulata* and *Metatropis tipularius* in the collection of the British Museum; one damaged specimen (Melville Is., N.T., W. D. Dodd), in the collection of the South Australian Museum.

Genus METACANTHUS Costa 1838.

Metacanthus Costa 1838, Cim. Regni Neap. Cent., 1, 27, (Haplotype *M. meridionale* Costa, a European species). Bergroth 1914 *Wien Ent. Zeit.*, xxxiii, 182.

Megalomerium Fieber 1854, *Wien. Ent. Monats.*, 208; Fieber 1861, Europ. Hem. 54 and 231; Lethierry and Severin 1894, Cat. Hem. II, 131; Oshanin 1906–9, Verz. Pal. Hem. I, 242.

Apex of head moderately subacutely produced, second and third segments of antennae subequal, rostrum reaching hind coxae. Pronotum twice as long as broad, with a distinct anterior collar, posterior two-thirds convex, and with a low central keel. Hemielytra nearly reaching or surpassing the apex of abdomen, and the process of the odoriferous aperture is produced into an upwardly directed spine which surpasses the level of the hemielytra and is recurved backwards at the tip.

The genus is represented in Europe, Africa, Asia, Indonesia, New Guinea and Australia.

KEY TO AUSTRALIAN SPECIES OF *METACANTHUS*.

1. Species small (4–5 mm. long), yellowish 2
   Species larger (7–8 mm. long), dark brown . . . . *M. pluto* sp. nov.

2. First segment of antennae, femora and tibiae with narrow brown or black annulations 3
   First segment of antennae, femora and tibiae not annulated *M. pertenerus* (Bredd).

3. Species 5 mm. long; annulations brown *M. pertenerus vittatus* subsp. nov.
   Species 4 mm. long; annulations black . . . . *M. tenellus* (Horvath)

METACANTHUS PERTENERUS (Breddin 1907).

Megalomerium pertenerum Breddin 1907, *Deuts. Ent. Zeit.*, 37; Distant 1918, Faun. Brit. Ind. Rhynch. VII, 176, fig. 82.

Colouration: very light yellow; the clavate distal ends of the first segment of the antennae and the femora, and the apices of the tibiae brownish; the two terminal segments of the tarsi, tip of the rostrum, and basal two-thirds of the last (fusiform) segment of the antennae black; terminal third of last antennal segment white; eyes and dorsal surface of abdomen red.

Structure: first antennal segment somewhat shorter than segments two and three together, segment two longer than segment three, ratio 60 : 35 : 30 : 10.

Length 5 mm. Width 0·5 mm.

Habitat. India and Ceylon.

METACANTHUS PERTENERUS VITTATUS subsp. nov.

This Australian variety differs from the typical Indian, in that the first segment of the antennae, the femora, and the tibiae, are banded with narrow brown annulations, except on the clubbed distal ends of the first antennal segment and the femora, where there is a broad annulation.

Habitat. Australia, Northern Territory (nine specimens, Roper River, N. B. Tindale).

Types. Holotype, allotype and four paratypes in the collection of the South Australian Museum (No. I.20027); three paratypes in the collection of the British Museum.

The underside of the abdomen in both subspecies, has a greenish tinge, indicating that it is probably grass green in life.

METACANTHUS TENELLUS (Horvath) 1905.

Megalomerium tenellum Horvath 1905, *Ann. Mus. Nat. Hung.*, III, (1), 57.

Whitish testaceous; head palely reddish testaceous, smooth, vertex seen from the side not very convex, almost subhorizontal, tylus produced; the first segment of the antennae remotely and narrowly annulated with black towards the base, apex lightly clubbed and somewhat infuscated, fourth segment black, apex white; pronotum densely and finely punctate on almost its entire surface, two small basal obsolete callosities on the anterior lobe however, are smooth, the lateral margins of the posterior lobe are parallel; the spine on the scutellum is subvertical, shorter than the posterior margin of the pronotum with an acute

apex; hemielytra just surpassing the apex of the abdomen; thorax ventrally punctate; legs narrowly and remotely annulated with black; femora lightly clavate and somewhat infuscated at the apex, tarsi apically black.—Horvath.

Length 4 mm.

This species differs from *M. pertenerus* in its smaller size and darker colouration; as however I have not seen this species, I am unable to say whether it is also a subspecies of the "*pertenerus*" group, in which case, as it is the prior species, *M. pertenerus* and *M. pertenerus vittatus* would fall under its synonomy as subspecies.

Habitat. New Guinea, Madang (Friedrich Wilhelmshafen).

METACANTHUS PLUTO sp. nov.

Fig. 3, a–b.

Colouration: reddish brown; fasciae behind the eyes, pronotum in the vicinity of anterior dorsal callosities, and regions above the anterior subcoxae laterally, scutellum and its spine, thoracic sternites, dorsal surface and portions of ventral surface of the abdomen, tips of tibiae and tarsi, darker brown to blackish brown; basal two-thirds of last segment of antennae black, apical third white.

Structure: Ratio of antennal segments 60 : 36 : 29 : 8, vertex of head fairly convex, ocelli nearer eyes than to each other; first segment of the rostrum reaching about to the anteocellary sulcus.

Length 7–8 mm. Width 1 mm.

This large dark species contrasts sharply with the other small yellowish species in this genus, and in size and overall colouration, superficially resembles *Capyella malacaipus* and *C. lobulata.*

It appears to be closely related to *Pneustocerus nigricornis* Horvath and *P. brevispina* Horvath, in dimensions and colouration, but it only differs from Horvath's description of *Pneustocerus* in not having the punctate clavus. Structurally it also does not differ significantly from the other species of *Metacanthus.*

It appears that there is need for some clarification of the status of *Pneustocerus* Horvath.

Habitat. Queensland; Bunya Mts., 2,000–3,000 ft., 24.12.37, N. Geary; Magnetic Is., A. M. Lea. N. S. Wales: Upper Williams River, Oct., 1925, Lea and Wilson.

Types. Holotype and allotype in the collection of the Australian Museum, Sydney; two paratypes in the collection of the South Australian Museum (No. I.20028), and one paratype in the collection of the British Museum.

Genus PNEUSTOCERUS Horvath 1905.

Pneustocerus Horvath 1905, *Ann. Mus. Nat. Hung.*, III (1), 59.

(Haplotype *P. nigricornis* Horvath, a New Guinea species).

Body strongly elongated. Head unarmed; vertex tumidly elevated, marked off from tylus by a transverse impression. Ocelli more remote from each other than from eyes. . Antennae slender, very long, longer than body, first segment subequal to the subsequent segments in length, apex clavate, second segment a little longer than third, fourth segment narrow, elongate, and fusiform. Rostrum reaching posterior coxae, basal segment half length of head. Pronotum anteriorly truncate, posteriorly lightly sinuate, constricted towards front, convex, angles not prominent, posterior margin attenuate and depressed, median keel obsolete and disappearing posteriorly, humeral angles hardly tumescent. Scutellum armed with a long erect spine. Hemielytra complete, clavus punctate, corium impunctate. Odoriferous orifices furnished with a long erect process, whose apex is sharply turned back. Legs very long; femora apically clavate, posterior femora surpassing the apex of the abdomen. Venter impunctate. (Horvath).

The genus has species in New Guinea and Borneo.

PNEUSTOCERUS NIGRICORNIS Horvath 1905.

Pneustocerus nigricornis Horvath 1905, *Ann. Nat. Mus. Hung.*, III ,(1), 59.

Reddish-testaceous; head smooth, impunctate, often a lateral obsolete postocular fuscus band is present, vertex strongly convex; antennae black, first segment becoming pale at base, apex lightly clavate, apical half of the fourth segment white; pronotum densely and distinctly punctate, provided with a smooth transverse subapical callosity, sides moderately rounded; spine on the scutellum straight, vertical, equal to half the posterior margin of the pronotum, apex acute; hemielytra a little shorter than abdomen, extending to apex of penultimate dorsal segment; process of odoriferous orifices becoming black at the apex; clubs of femora, tibiae, and tarsi black. (Horvath).

Length 8–9 mm.

Habitat. New Guinea.

I have not seen this species or any member of its genus.

Genus GAMPSOCORIS Fuss 1852.

Gampsocoris Fuss 1852, *Mitth. Ver. Hermanstadt* 7, (Haplotype *G. punctipes* (Germar), a European species). Bergroth 1914, *Wien Ent. Zeit.* xxxiii, 182.

Metacanthus Costa 1848, *Atti. Ac. Nap.* VII, 258; Fieber 1859, *Wein Ent. Monats.* 209; Fieber 1811, Europ. Hem. 213; Douglas and Scott 1865, Brit. Hem. I, 115; Saunders 1892, Hem. Het. Brit. Is., 15; Lethierry and Severin 1894, Cat. Hem. II, 132; Distant 1902, Faun. Brit. India, Rhynch. I, 422.

Armanus Mulsant and Rey 1870, Pun. France, Cor. 187.

Vertex of head raised and convex, second and third segments of antennae subequal, pronotum not twice as long as broad, convexly raised and tritubercu-late posteriorly, clavus very short, and apical margin of the corium very long. Scutellum equipped with a long curved spine, process of the odoriferous aper-tures neither strongly produced nor surpassing the level of the hemielytra in *G. punctipes,* but is strongly produced, and surpasses the level of the hemielytra in *G. pulchellus.*

The genus is cosmopolitan, there is only one species in this region.

GAMPSOCORIS PULCHELLUS (Dallas) 1852.

Metacanthus pulchellus Dallas 1852, List. Hem. II, 490; Distant 1902, Faun. Brit. India, Rhynch. I, 243, fig. 248.

Colouration: pale yellow, tending brownish in some specimens; first three segments of the antennae, femora, and tibiae with numerous brown or black annulations; clubs of femora tips of tibiae and two terminal tarsal segments brown.

Structure: Pronotum with anterior margin convex and without tubercles, but with three whitish tubercles forming a transverse line on the dorsal surface above the fore coxae (homologous with the callous area in this position in other species of Neidids). Process of the odoriferous apertures prolonged into an upwardly directed process, which surpasses the level of the hemielytra (as in species of *Metacanthus*—this is not shown in Distant's figure).

Length 3·5–4·5 mm. Width 0·75 mm.

Habitat. India, Java, New Guinea (Misima Is.), Australia (Darwin). The Darwin species are somewhat paler than the Indian and Misima Is. speci-mens.

There are eleven specimens (two Darwin, G. F. Hill, and nine Misima Is., Papua, Rev. H. K. Bartlett) in the collection of the South Australian Museum, and four specimens (two of the Darwin series and two of the Misima series) in the collection of the British Museum.

Genus PROTACANTHUS Uhler 1893.

Protacanthus Uhler 1893, *Proc. Zool. Soc.* London, 707, (Haplotype *P. decorus* Uhler, a West Indian species). China 1930, Ins. Samoa II, fasc. 3, 111.

Auchenoplus Bergroth 1913, *Mem. Soc. Ent. Belgique,* 22, 179.

Rostrum reaching posterior coxae, basal segment not as long as head, second and third segments of antennae subequal. Pronotum anteriorly armed on each side with an obliquely directed spine and equipped with a prominent central keel and trituberculate posteriorly. Hemielytra longer than abdomen, which tapers from base to apex. Scutellum armed with a prominent spine, process of the odoriferous apertures not prolonged vertically above the level of the hemielytra.

Has species in the West Indies, Polynesia, Australia and India.

PROTACANTHUS PACIFICUS China 1930.

Protacanthus pacificus China 1930, Ins. Samoa II, fasc. 3 111, fig. 2.

Anterior lobe of head (in front of ocelli) and eyes intense shining black, remainder fulvous, flecked with brown. Pronotum fulvous anteriorly and shading through brown to black posteriorly, abdomen pale green.

Head with a few short hairs, especally at apex of rostrum, reaching almost to second abdominal segment, relative lengths of segments, 35 : 17 : 20 : 22. Humeral angles of pronotum sub-globosely swollen, the median longitudinal keel on disc very distinct posteriorly, strongly elevated between the tumescent humeral lobes and dilated to form an elongate lobe-like protusion. Spines of anterior collar robust, about as long as head is wide between eyes. Hemielytra extending well beyond the apex of the abdomen. (Abbreviated from China).

Length 4 mm. Width 0·72 mm.

Habitat. Samoa and Fiji.

PROTACANTHUS HALEI sp. nov.

Fig. 4, a–b.

Colouration: light yellowish brown; thoracic sternites brown; last segment of antennae, tip of rostrum, terminal two tarsal segments and a longitudinal line on inner prolongation of each corium black.

Structure: first segment of antennae slightly shorter than next two together, ratio of segments, 35 : 20 : 22 : 9; vertex tumescently carinate, head with scat-

tered hairs, especially on the crown of carina of vertex and tylus. Pronotum with a low upwardly and outwardly directed spine on each antero-lateral margin, (ratio of spine length to anterior width of pronotum is 1 : 6), and with three nodules, one on each lateral carina and the other (laminate and procurved in side view) on the central keel, all three directly above the fore coxae in position. Abdomen impunctate, hind femora surpassing apex of hemielytra.

Length 3·5–4·5 mm. Width 0·5 mm.

This species differs from *P. pacificus* China, in not having black on either the head or the pronotum, and in the shorter rostrum and pronotal spines, and from *P. bihamatus* Dist. in not having black on the head, and in the shorter pronotal spines.

Habitat. South Australia: (Moolooloo, 2,000 ft., Flinders Ranges, Northern South Australia 1921, H. M. Hale).

Types: Holotype and allotype in the collection of the South Australian Museum (No. I.20029).

REFERENCES.

Bergroth, E. (1909) : *Ann. Soc. Ent. Belg.*, 53, 188–189.
Bergroth, E. (1913) : *Mem. Soc. Ent. Belg.*, 22, 179.
Bergroth (1914) : *Wien. Ent. Zeit.*, 33, 182.
Blöte, H. C. (1945) : *Zool. Meded.*, XXV, 72, 76.
Breddin, G. (1907) : *Deuts. Ent. Zeit.*, 36–38.
Buchanan White, F. (1878) : *Ent. Mon. Mag.*, 15, 31.
China, W. E. (1930) : Insects of Samoa, II, fasc. 3, 111–112.
Costa, A. (1838) : Cim. Regni Neap., Cent. I, 27.
Costa, A. (1848) : *Atti Ac. Nap.*, VII, 258.
Dallas, W. S. (1851) : List. Hem., II, 488–91.
Distant, W. L. (1901) : Faun. Brit. Ind. Rynch., I, 421–24.
Distant, W. L. (1908) : Faun. Brit. Ind. Rynch., IV, 487–490.
Distant, W. L. (1911) : *Ann. Mag. Nat. Hist.*, (8), 7, (42), 585.
Distant, W. L. (1918) : Faun. Brit. Ind. Rynch., VII, 173–8.
Douglas, J. W. and Scott, J. (1865) : The British Hem., 145–162.
Fieber, F. X. (1854) : *Wien. Ent. Monats.* 108.
Fieber, F. X. (1861) : "Europ. Hem." 54 and 213.
Fuss, C. A. (1852) : *Mitth. Ver. Hermannstadt*, 7.
Horvath, G. (1905) : *Ann. Mus. Nat. Hung.*, III (1), 57–9.
Hutton, F. W. (1897) : *Trans. Proc. N.Z. Inst.*, XXX, 172.

Lethierry, L. and Severin, G. (1894) : Cat. Gen. Hem., II, 127–33.
Myers, J. G. (1926) : *Trans. Proc. N.Z. Inst.*, 56, 85–6 and 454.
Saunders, E. (1892) : Hem. Het. Brit. Is., 61, 5.
Stal, C. (1855) : *Ofvers, Vet. Ak. Forh.*, 30.
Stal, C. (1865) : Hem. Afr., 2, 119–20.
Stal. C. (1874) : Enum. Hem. IV in *Kongl. Svenska. Vet. Ak. Handl.* B 12, (1), 127–8.
Tillyard, R. J. (1926) : Insects Aust. and N.Z., 147–8.
Uhler, P. R. (1893) : *Proc. Zool. Soc.*, 707–708.
Van Duzee, E. P. (1917) : Cat. Hem. Am. North of Mex., 142–5.

On a NEW SPECIES of CRYPTOSTEMMATIDAE (HEMIPTERA-HETEROPTERA) from AUSTRALIA

By GORDON F. GROSS, B.Sc., South Australian Museum.

The following new species of the Family Cryptostemmatidae is apparently the first to be recorded from Australia. The species belongs to *Ceratocombus* Signoret, and the wing venation (fig. C, D) shows that it is to be placed in the subgenus *Xylonannus* Reuter.

Ceratocombus (Xylonannus) australiensis sp. nov.

Holotype male; *forma brachyptera.*

Dark brown; rostrum, antennae and legs yellowish. Head with scattered long hairs (up to 0·15 mm.), eyes in lateral view distinctly higher than long, posterior margins concave. Antennae covered with long hairs (up to 0·13 mm.), third joint thicker at base than apex, tapering from former to latter, fourth joint with two incrassations one situated ⅓, the other ⅔ of its length, lengths of segments 0·06 mm., 0·17 mm., 0·42 mm., and 0·47 mm. Rostrum just reaching third coxae, first segment with scattered fine hairs, second and third apparently glabrous, lengths of segments 0·07 mm., 0·27 mm., and 0·25 mm.

Anterior femora somewhat incrassated, anterior tibiae thicker at apex than base, femora and tibiae apparently laterally compressed. All leg-segments pilose, the hairs on coxae much shorter than on other segments.

Pronotum trapeziform with a medial longitudinal impression and the groove demarcating the apical constriction more or less interrupted centrally. Anterior margins slightly convex, posterior strongly concave, lateral margins slightly convex before and again behind the apical constriction. Lateral margins and disc with short hairs. Dimensions of pronotum, anterior width 0·29 mm., posterior width 0·33 mm., greatest length 0·26 mm. Scutellum triangular, apical angle rounded.

Underside of abdomen with sparse short hairs becoming longer and more profuse on and in the vicinity of the genital segments. Venation of brachypterous elytra as in figure, covered with short hairs (0·03 mm.), which are not restricted to the veins and particularly numerous on the costal margin extending almost to apex.

Length 1·6 mm. Greatest width 0·48 mm.

Allotype female; *forma brachyptera.*

Similar to male but larger, with last joint of antennae apparently simple without the two incrassations of the male. Dimensions pronotum, anterior width 0·35 mm., posterior width 0·46 mm., greatest length 0·29 mm. Lengths antennal segments, 0·08 mm., 0·20 mm., 0·44 mm., and 0·46 mm.; lengths rostral segments, 0·10 mm., 0·39 mm., and 0·33 mm.

Length 1·7 mm. Greatest width 0·52 mm.

Paratype female; *forma macroptera.*

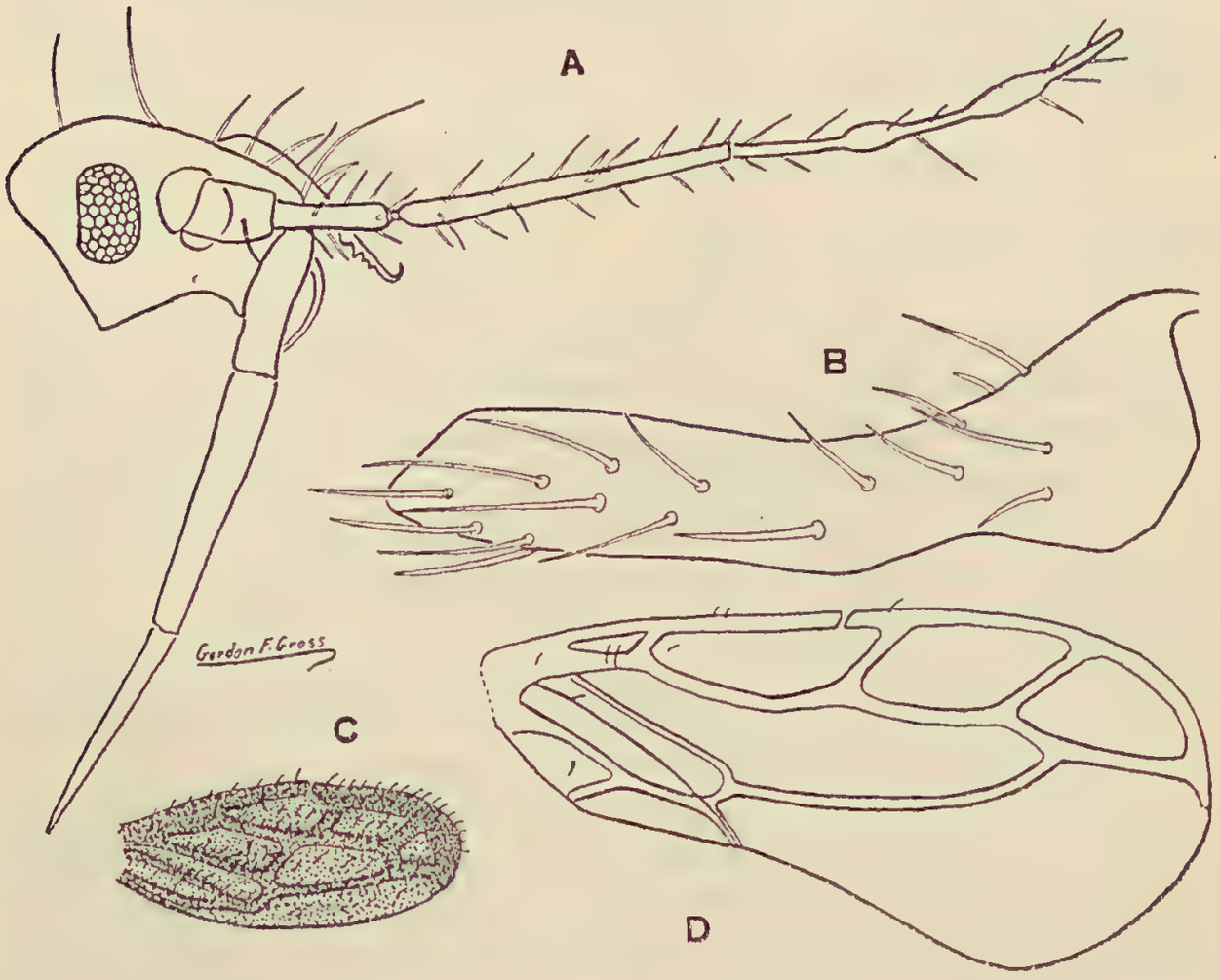


Fig. 1. *Ceratocombus* (*Xylonannus*) *australiensis*: A, lateral view of male head; B, lateral view of right larger male clasper; C, brachypterous elytron; D, macropterous elytron.

Only one of the paratypes is macropterous and as the specimen was carded and in bad condition, only the hemielytra are described (fig. D).

This shows a rather peculiar condition in that there is a single central large elongate cell formed by the disappearance of a cross vein which is present in the macropterous condition of all other species of *Xylonannus* and in the brachypterous condition of *C.* (*X*) *australiensis* (cf. figs. C and D). The hairs are also very much more sparse than on the brachypterous hemielytron figured.

This species differs from *C.* (*X.*) *enderleini* Poppius, to which it seems most closely allied in the darker coloration and in the structure of the larger clasper of the male which is not provided basally with an inwardly directed tooth, whilst from *C.* (*X.*) *toda* Hutchinson, in its smaller size and in having the groove demarcating the apical constriction of the pronotum more or less interrupted centrally, and from *C.* (*X.*) *corticalis* Reuter, and *C.* (*X.*) *taivanus* Poppius in having hairs on the disc of the elytra.

Holotype (I 20,038) and allotype (I 20,039) from Tapanappa, near C. Jervis, S. Aust., 6 Dec., 1949, G. F. Gross.

Paratypes from Mt. Lofty, Gawler and Melrose, S. Aust.; Waratah and Strahan, Tasmania; Upper Williams River, N.S.W.; Mt. Tambourine and Cairns District, Qld. and Lord Howe Island.

REFERENCES.

Hutchinson, G. E. (1944) : *Ann. Mag. Nat. Hist.* (11), 11, p. 774.

McAtee, W. L. and Malloch, J. R. (1925) ; *Proc. U.S. Nat. Mus.*, 67, art. 13, fig. 1–42.

Poppius, B. (1910) : *Ann. Soc. Ent. Belg.*, 54, p. 234.

Poppius, B. (1915) : *Arch. Naturges.* 80, A8, 76, p. 78.

Reuter, O. M. (1891) : *Acta Soc. Sci. Fennica*, 19, pp. 1–28.

On the FEMALE of the DIPTERON *SCATOPSE APTERA* Womersley 1942

By H. WOMERSLEY, Entomologist, South Australian Museum.

Fig. 1.

In 1942, the author (*Trans. Roy. Soc., S. Aust.*, 66, (1), 74) described *Scatopse aptera* from two males found amongst the debris of a decayed Yacca (*Xanthorrhoea*) stump from Adelaide, April 10, 1939, collected by Dr. R. V. Southcott by means of the Berlese funnel.

Recently three males and a single female were found in similar pabulum from Tapanappa, near Cape Jervis, South Australia, collected by Mr. G. F. Gross, December 6, 1949.

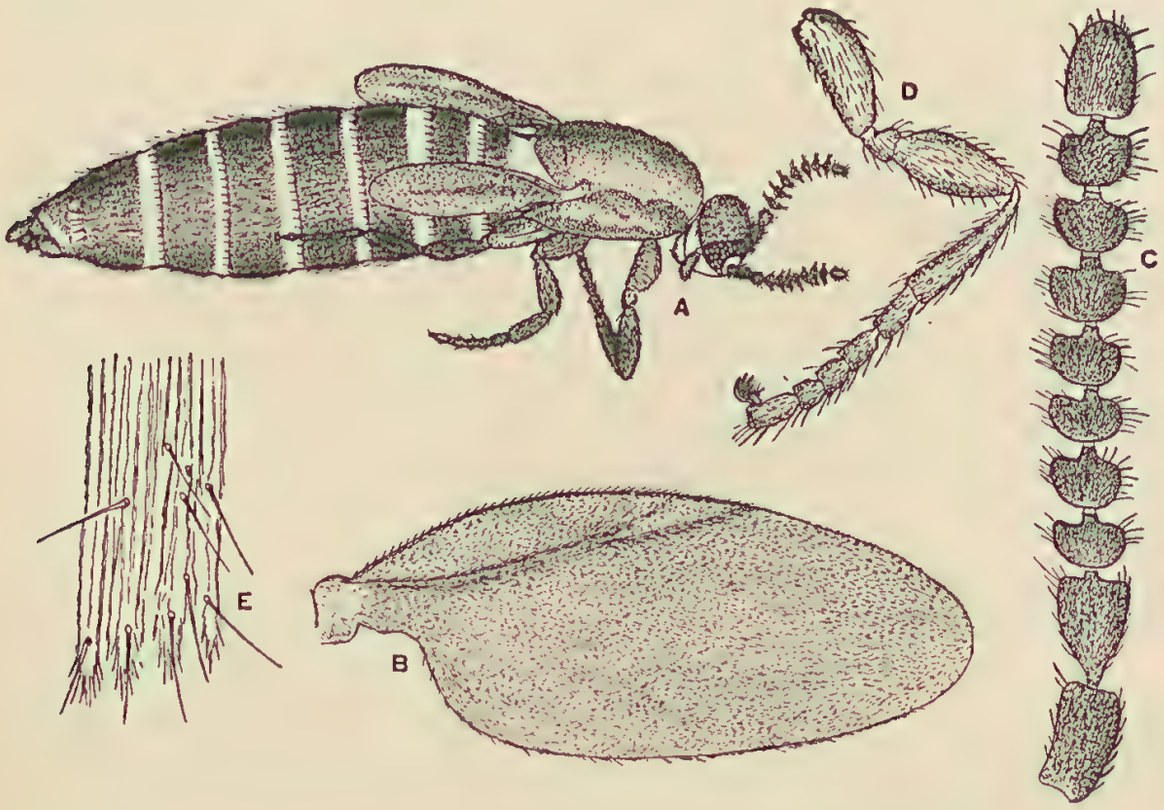


Fig. 1. *Scatopse aptera.* A, female; B, wing of female; C, antenna of male; D, leg I of male; E, dorsal striations of abdominal segment III of female.

The solitary allotype female was found to be brachypterous, and is described as follows:

Female: Colour entirely dark as in male, except for the lighter intersegmental membranes. Length, 3·0 mm. Wings present, brownish in colour, shortened, 1·04 mm. long, in repose folded longitudinally; Sc. and R. only, distinctly present, and furnished with spines, R. ending slightly beyond midway of the anterior margin; anterior margin spinose to end of R.; membrane finely covered with microtricheae. Halteres present and well developed. Eyes as in male. Antennae 10-segmented, rather longer than head. Palpi 1-segmented, as in male. Legs as in male, tarsi 5-segmented (in the description of the male, the tarsi were erroneously stated to be 4-segmented). Abdomen, both dorsally and ventrally longitudinally striated (see text fig. E.).

Loc.: Holotype male and 1 paratype previously recorded from Adelaide, April, 1939; allotype female and 3 males from Tapanappa, near Cape Jervis, S. Aust., December, 1949.

MOLLUSCA FROM WESTERN AUSTRALIA

By BERNARD C. COTTON, Conchologist, South Australian Museum.

During a recent visit to Western Australia, opportunity was taken to explore the beaches of that interesting region. A representative collection of Mollusca was obtained then and further specimens have been collected and forwarded to the South Australian Museum by enthusiastic students at the University of Western Australia.

A few brief notes on some Western Australian species are submitted.

Saxostrea australis (Lamarck).

Ostrea australis Lamarck 1819. An. S. Vert., 6, p. 209.

This species was originally described from King George Sound. It is living on the reefs at Cottesloe and we have it from Albany, Fremantle and Garden Island. Specimens in the South Australian Museum Collections were labelled "*O. mordax* Saville-Kent" which is a Queensland species, "*O. glomerata* Gould" a New Zealand oyster and "*O. cucullata* Born", a West Indian shell. In South Australia living specimens have been taken at Corny Point, Coffins Bay, and dredged in shallow water off St. Francis Island. It has long been suspected that two oysters, the common "Port Lincoln" Mud-oyster and a second rarer "rock oyster" allied to the "Sydney Rock Oyster" occur in South Australia, and this theory has proved correct.

S. australis is more circular and flatter than the Peronian *S. commercialis* Iredale, though it has a sinuated turned up edge and bluish interior usually associated with *Saxostrea*. *Saxostrea scyphophilla* Peron 1807 recently recognized from Sharks Bay is quite distinct, as specimens of that species about 35 mm. in diameter are produced into the distinctive tubular form about 70 mm. in length. A few specimens of *S. australis* taken alive at Cottesloe up to 50 mm. in diameter are of the usual flat, oyster shape.

S. australis has not yet been found in Eastern South Australia. Confusing evidence of the existence of a rock oyster in South Australia has been accentuated in the past by frequent finds of discarded "Sydney Rock" shells on the beaches in the vicinity of Outer Harbour.

SAXOSTREA SCYPHOPHILLA (Peron)

Ostrea scyphophilla Peron 1807. Voy. Decouv. Terres. Austr, 1, p. 119.

Mr. Edgar Mundy, of Port Lincoln, has large and typical specimens of this species taken at "Franklin Harbour, Cowell, in creek, left hand side, just in the entrance, 1910." Mr. Mundy writes that the "Mangrove Oyster" was plentiful in those days at Cowell, Shoal Water Point and Port Augusta. A specimen sent to F. L. Saunders, of Adelaide, from the original series, measures 80 mm. in length and the aperture of the "horn" is 40 mm. The shell has a dark violet colouration externally and on the inner margin, somewhat like that of *S. australis*.

PROXICHIONE LAQUEATA (Sowerby).

Venus laqueata Sowerby 1853. Thes., Conch., 2, p. 706, p. 153, fig. 15.

This big cockle was described from Swan River, Western Australia, and we have specimens from Garden Island and Cossack. The species is a little variable in shape and sculpture but it is consistently smaller and differently shaped from the "Mother Cockle" *Proxichione materna* Iredale of New South Wales. J. T. Veitch took a living specimen of *P. laqueata* measuring 70 mm. in length and 65 mm. in height at Spalding Bay, Port Lincoln. It is dark fawn coloured with a couple of dark-brownish-red radials. In sculpture and colouration the specimen somewhat resembles *Venus puerpera* Linne 1771 found in the Philippines and Queensland. This is the only specimen I have seen from South Australia, dead or alive, and it constitutes a new record for the State. An ancestor of this species, *P. cognata* Pritchard occurs in the "Adelaidean" Lower Pliocene, and a similar species has been noticed recently in what may be "Werrikooian" Upper Pliocene material from Kangaroo Island. Another relative is *P. dimorphylla* Tate from the Middle and Upper Miocene of South Australia.

Superfamily CYPRAEACEA.

Hedley in his "Preliminary Index of the Mollusca of Western Australia" 1916 listed forty species, but about seventy species occur in Western Australia. E. H. Bardwell forwarded to me a list of North Western Australian cowries collected by B. E. Bardwell. The following were not on my manuscript list from that region, but can be added now on Bardwell's authority, his identification being followed by the name used in modern lists.

Ovulum ovum Linne. *Amphiperas ovum* Linne. Brue Reef.
Cypraea staphylaea Linne. *Staphylaea staphylaea* Linne. Gantheaume Point.
Cypraea angustata Linne. *Notocypraea verconis* Cotton and Godfrey. Abrolhos Islands.
Cypraea asellus Linne. *Evenaria asellus* Linne. N.W.A.
Cypraea notata Gill. Maybe *Paulonaria macula hilda* Iredale. Roebuck Bay.
Cypraea quadrimaculata Gray. *Bistolida quadrimaculata* Gray. Roebuck Bay.
Cypraea talpa Linne. *Talparia talpa* Linne. Fort George.
Cypraea variolaria Lamarck. *Ovatipsa chinensis variolaria* Lamarck. N.W.A.
Cypraea eburnea Barnes. *Albacypraea eburnea* Barnes. Anson Bay.

Among Cowries collected by R. W. Tymms at Broome was a specimen of *Bistolida stolida*, which was also listed from Roebuck Bay by Bardwell.

ZOILA VERCOI (Schilder).

Zoila vercoi Schilder 1930. Zool. Anz., Bd. 92., p. 74.

The holotype D.969 is in the South Australian Museum and there are two paratypes, all from Esperance. Three specimens of this so-called "Esperance Cowry" were noted in the collection of H. Rossell, Subiaco. One of these he donated to this Museum. All specimens are quite distinct from *Zoila friendii* Gray originally taken at "Swan River."

ZOILA ROSSELLI (Cotton).

Zoila rosselli Cotton 1948. Trans. Roy. Soc. S. Aust., Vol. 72, pt. 1, p. 30, pl. 1, fig. 1–6.

Zoila marginata Gaskoin 1848, unfigured and from unknown locality, was thought by Iredale to be an immature *Z. friendii* and Schilder placed it as a separate species following *Z. friendii* in his great work "Living Cypraeidae". *Z. marginata* may be a deep water relative of *Z. rosselli* though it is difficult to decide until the unique specimen in the British Museum is compared. *Z. marginata* is described as a pellucid shell, having brown dorsal spots, sides and base white, teeth produced, spire greatly produced. *Z. rosselli* is rather thick, margins and extremities calloused, dorsum unicoloured light brown, medium-brown base and margins, teeth slightly produced, spire not produced.

GUTTACYPRAEA PULICARIA (Reeve).

Cypraea pulicaria Reeve 1846. Conch. Icon. 3, pl. 17, fig. 84, sp. 84.

A good series of this species taken by H. Rossell at Leighton, South Western Australia, shows little variation. Its deep pink colouring, four bands, brown maculations and spotted margins distinguish this littoral species from the deep water *G. euclia* Steadman and Cotton 1946. *G. pulcaria* we also have from Point Peron.

RAVITRONA CAPUTSERPENTIS (Linne).

Cypraea caputserpentis Linne 1758. Syst. Nat. ed. 10, p. 720.

The type came from Mauritius. *Cypraea caputserpentis kenyonae* Schilder and Schilder 1939, from Western Australia differs from *R. caputserpentis* in being oval in shape, sides not thickened or angulated, dorsum not flattened or depressed, dark brown, base cream.

A good series of this species from Leighton, Cottesloe and Rottnest suggests that the name *R. kenyonae* may be based on a juvenile shell as senile specimens show every characteristic of the true *R. caputserpentis*. Three varieties separated by collectors and forwarded for identification were merely series of juvenile, mature and senile specimens respectively.

RAVITRONA HELVOLA (Linne).

Cypraea helvola Linne 1758. Syst. Nat. ed. 10, p. 720.

The Western Australian variant has a tendency to coarser teeth and a greenish tinge in the colouration. A series of eight from Cottesloe and Rottnest are almost typical *R. helvola*, but one from Leighton has the characteristics of *R. helvola citriniolor* Iredale 1935, a name introduced for the Western Australian variant.

MYASTAPONDA VITELLUS (Linne).

Cypraea vitellus Linne 1758. Syst. Nat. ed. 10, p. 721.

A dead shell of this species from Leighton, South Western Australia, measures 56 mm. in length.

EXOHALIOTIS CYCLOBATES (Peron).

Haliotis cyclobates Peron 1816. Voy. Decouv. Terres. Austr., 2, p. 80.

The type came from Kangaroo Island, South Australia, where the species is common. A number of worn, senile, though typical specimens from Murchison were forwarded for identification by the University of Western Australia. It is extraordinary to find this species at Murchison when it appears to be absent in the South-West.

CAMPANILE SYMBOLICUM Iredale.

Campanile symbolicum Iredale 1917, Proc. Mal. Soc. Lond., 12, p. 326.

There has been some dispute regarding the genotype of this genus. It seems almost certain that Fischer's words in the original descripiton, "Opercule typique (*C. laeve* Quoy et Gaimard, Australia)" leaves no doubt but that *C. laeve* was intended as genotype. Fisher follows this by remarking that the fossil species of the group are numerous in the Eocene and gives an example of the fossil species by quoting *G. giganteum*. I am inclined to agree with Wrigley, Proc. Mal. Soc. Lond., 24, p. 97, 1940, that the living Australian species is congeneric with the British Eocene fossils. *Campanile* has a considerable geological and geographical range. It is found in the Upper Cretaceous, Eocene, Oligocene, Miocene, in localities ranging from the West Coast of North America, South America, Europe, North Africa, India, East Indies, to Southern Australia.

It is probable that the large *Terebralia adelaidensis* Howchin and Cotton 1936 from the Lower Pliocene (Adelaidean) of South Australia should be placed in *Campanile* as the apertural features of the Northern Australian *Terebralia* (genotype *T. pallustris* Bruguière) appear to be different. *Campanile symbolicum* (not *C. laeve* Quoy et Gaimard 1834, which is preoccupied by *Cerithium laevis* Perry 1810) occurs as a raised beach subfossil on Yorke Peninsula. South Australian specimens measuring up to 150 mm. in length being found there. We have good series of Western Australian recent specimens from Fremantle, Albany, Hopetoun, Yallingup, King George Sound and Geraldton.

The shell is not uncommon alive at Garden Island and a large specimen from that locality, examined at the University of Western Australia measured 200 mm. in length and 70 mm. in width.

DYRASPIS DORREENSIS (Peron).

Conus dorreensis Peron 1807. Voy. Decouv. Terres Austr., 1, p. 120.

This distinctive cone shell was taken by students at Murchison, and a fine living specimen at Garden Island. I had previously recorded it as far south as Ellenbrook and Yallingup from dead specimens, under the name *Virroconus pontificalis.*

A new genus *Dyraspis* Iredale 1949, has since been introduced for this peculiar cone and the specific name *C. pontificalis* Lamarck 1810 is replaced by the earlier *C. dorreensis* Peron, described from Dorre Is.

MEGALATRACTUS ARUANUS (Linne).

Murex aruanus Linne 1758. Syst. Nat. ed. 10, p. 275.

Shells of this "largest living gastropod" are found at Cottesloe, Rottnest and Penguin Islands in South Western Australia. Hedley, in 1905, recorded it as far south as Exmouth Gulf and in a footnote mentions that a specimen of the egg case had been collected on Carnac Island, seven miles south-west of Fremantle. Specimens may be distinguished from the Northern ones by the less elevated spire, rounder outline of the spire and body-whorl, and also smaller size of the southern form.

CONCLUSION.

Preliminary studies strongly suggest that there is some marked tropical influence, probably a warm current washing the South Western Australian shores during at least part of the year. This theory is supported by the range of certain tropical species mentioned here which are found much further south than could be expected under normal conditions in this area.

Some AUSTRALIAN CARYOPHYLLAEID CESTODES

By T. HARVEY JOHNSTON and NANCY G. MUIRHEAD,
University of Adelaide.

Fig. 1–10.

The present paper records the occurrence of four species of Caryophyllaeid cestodes from the intestine of the widely distributed Australian freshwater Siluroid catfish, *Tandanus tandanus* Mitchell. One of these, *Balanotaenia bancrofti*, had been previously described from material collected in eastern Queensland. The other three are considered to be new; two of them are assigned to a new genus of Lytocestinae, *Notolytocestus*, as *N. major* and *N. minor*; while the other is placed under *Biacetabulum* (*B. tandani*) and is the only known Australian representative of the Caryophyllaeinae.

Types of the new species have been deposited in the South Australian Museum, Adelaide. We desire to thank G. G. Jaensch and L. Ellis of Tailem Bend, South Australia, and our colleague, Miss L. M. Angel, for supplying most of the catfish; and to acknowledge our indebtedness to the Commonwealth Research Grant to the University of Adelaide.

Balanotaenia bancrofti Johnston.

Fig. 9–10.

This small species was the first described by Johnston (1924) from material collected from the upper Burnett River, Queensland, by Dr. J. M. Mackerras and her father, the late Dr. T. L. Bancroft.

We have examined catfish caught at Tailem Bend by Mr. G. G. Jaensch and at Murray Bridge by Mr. L. Ellis in 1939 and 1942 and Miss L. M. Angel in 1947 and 1948. Our findings were as follows, the locality being Tailem Bend unless otherwise stated: November 1937, one, infected; December 1937, two fish, both infected; May 1938, positive; January and February 1939, positive; October 1939, one positive and one negative; October and November 1939, from Murray Bridge, the former positive; February 1940, a very young fish, negative; March 1941, a very young fish, 1·25 inches long, negative; May 1941, four fish, 1·25–1·5 inches long, all negative; November 1941, many cestodes, some very large and some very small; February 1942, Murray Bridge, two fish, both infected,

some of the parasites being very young; March 1942, one positive and one negative; April 1945, very heavily infected; May 1945, heavily infected; April 1947, Murray Bridge, negative; December 1947, Murray Bridge, two fish, both infected; January 1948, Murray Bridge, two fish, both negative; May 1948, Murray Bridge, positive; February 1949, Murray Bridge, a fish under two inches long, negative. Thus of 32 fish examined, 18 contained *B. bancrofti*. All fish three inches or less in length, were free from infection. Since such small fish were all captured in a swamp, it is likely that the intermediate host lives in the deeper water of the river where larger catfish occur. If we exclude the seven very young fish, there were 18 of 25 adult fish found to be infected, i.e. 72 per cent.

Very young stages of the parasite, along with adults, were found in November, December, February, April and May. The heaviest infection was observed in April, 1945 when 156 *Balanotaenia* (including many young stages) were taken from one fish. The usual number was 12–20. There was no opportunity to examine catfish during the winter months (July–September). Infected fish were found during each of the remaining months.

Dr. J. Mackerras informed us that *B. bancrofti* occurs in *Tandanus tandanus* in the vicinity of Cairns, North Queensland; and one of us has examined material from the Murray in the vicinity of Mildura. The parasite is thus present in Queensland, New South Wales, Victoria and South Australia, its host fish occurring in the Murray-Darling river system and in the rivers of eastern Australia.

A detailed account of the anatomy of *B. bancrofti* was published in 1924. The smallest specimen which we obtained from the Murray region was about one millimetre in length, a size agreeing with the smallest of the worms from the Burnett River.

In one catfish taken by Miss Angel near Murray Bridge in December, 1947, there were present, beside numerous *Balanotaenia*, a few *Notolytocestus major*, together with one *N. minor* and one *Biacetabulum tandani*; while in another taken on the same occasion, there were two *N. major* as well as many *Balanotaenia*.

NOTOLYTOCESTUS MAJOR gen. et. sp. nov.

Fig. 1–5.

This relatively wide Caryophyllaeid was encountered only twice; on both occasions in *Tandanus tandanus* caught at Murray Bridge in December, 1947, *Balanotaenia* also being present. In one of these fish there was also a single specimen of *Notolytocestus minor* and of *Biacetabulum tandani*.

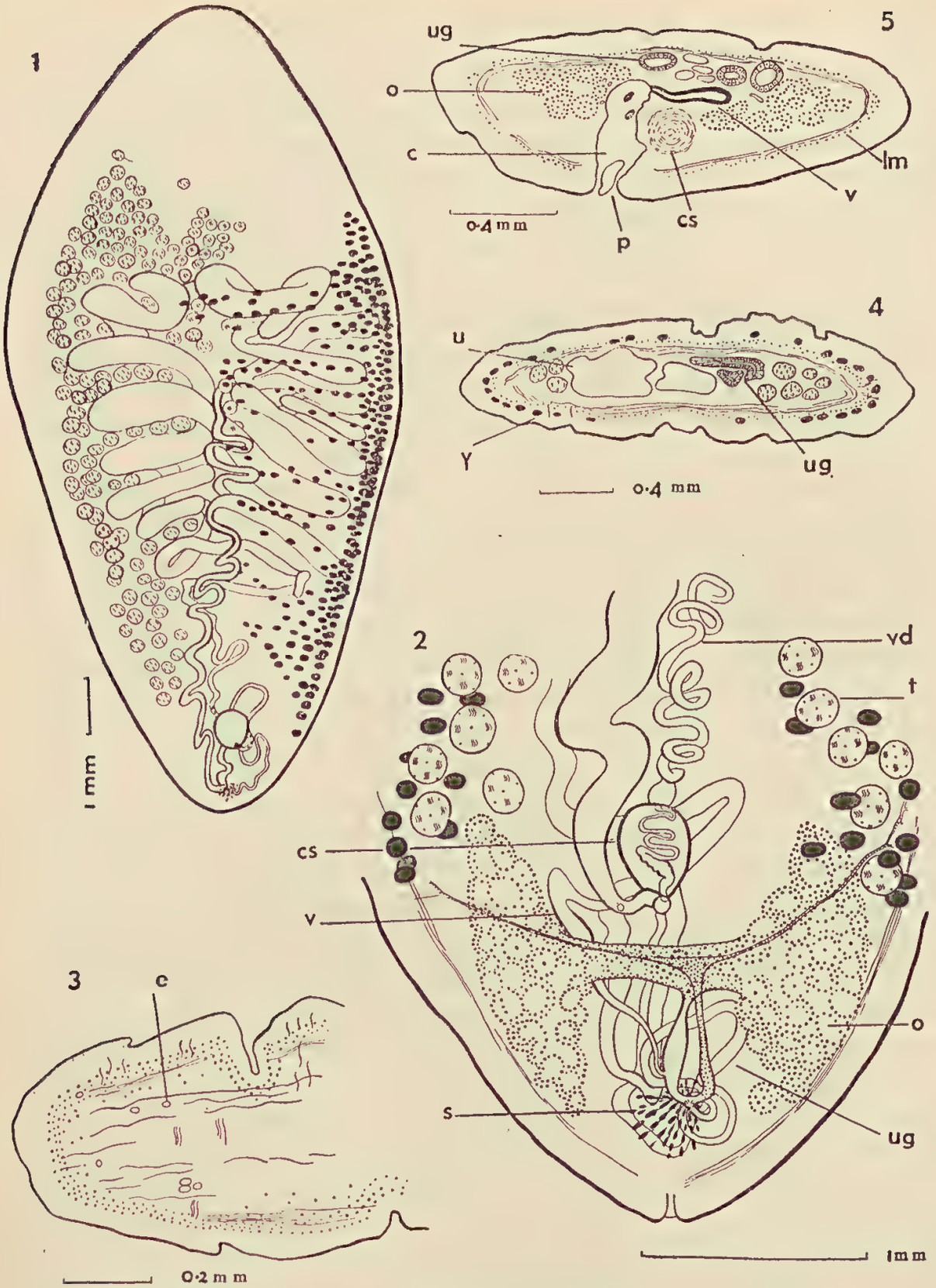


Fig. 1–5. *Notolytocestus major.* 1, ventral view, showing the path of the uterus, and on one side the distribution of the testes, on the other, the vitellaria; 2, reproductive system; 3, transverse section near anterior end showing musculature; 4, transverse section through uterine area showing both glandular and non-glandular uterus and arrangement of vitellaria; 5, transverse section through the genital pore and utero-vaginal canal showing entrance of vagina into the latter.

e utero-vaginal canal; cs cirrus sac; e excretory canal; lm longitudinal musculature; o ovary; s shell gland; p genital pore; t testes; u uterus; ug glandular uterus; v vagina; vd vas deferens; y vitellaria.

The measurements of adult *N. major* ranged from 17 mm. in length by 8 mm. in maximum breadth to 13 mm. by 5 mm. A specimen devoid of eggs measured 11·5 mm. by 5·5 mm. The region of greatest width was at about the end of the anterior third of the body length. The worms are flattened dorsoventrally, with the anterior end generally more bluntly rounded and sometimes provided with a small projection. Apart from the latter there is no differentiation of a scolex. The unspecialized nature of the anterior region of the worm is apparent in transverse sections. Just behind this there can be seen in sections small longitudinal furrows or grooves produced by contraction of the underlying muscles.

There is a very narrow band of small subcuticular longitudinal muscles, and lying more deeply in the cortex is a relatively wide band of numerous similar muscles, this zone being widest in the anterior region of the worm. Inwardly from this layer of longitudinal muscles are transverse muscle fibres forming a dorsal and a ventral series and at right angles to these are groups of dorsoventral muscle fibres extending into the cortex above and below (fig. 3).

Many excretory canals can be seen in the medulla of the scolex but in the rest of the body the canals come to be arranged in groups in the lateral regions of the medulla. These canals converge posteriorly to enter a wide excretory duct opening at the posterior end of the body. Nervous tissue may be seen in transverse sections lying laterally between the inner longitudinal musculature and the region where the excretory canals are situated.

Testes are very numerous and are confined to the medulla. Their position in relation to the vitellaria is indicated in fig. 1. Sections show that in the anterior part of the testicular field, where uterine coils are absent, the vesicles are arranged in a single row. This field extends from the end of the first fifth of the body length to reach the most anteriorly-directed ovarian lobes. The testes are round or oval, measuring on average ·23 mm. in diameter. They form a continuous layer in the pre-uterine region but become displaced by the uterine coils so that they then lie mainly laterally with comparatively few vesicles scattered between the uterine folds. They diminish in number posteriorly and only a few are to be seen lying dorsally to the anterior ovarian lobes. Numerous efferent ducts may be seen between the uterine folds and these eventually join to form a wide vas deferens at about the end of the second third of the body length. It is at first dorsal to the uterus and may come to lie either on the right or left side of the midline. The duct then becomes narrowed and much coiled before widening again into a thick-walled tube whose wall contains muscle fibres. In one preparation a thin-walled vesicula seminalis was seen adjacent to the cirrus sac, but such a structure was not recognized in sections. After entering the cirrus sac the male duct is differentiated into a narrow ejaculatory duct lying coiled in the anterior

part of the sac. The cirrus, when retracted, occupies the posterior portion of the sac from whose ventro-posterior aspect it can communicate with the utero-vaginal canal which in turn opens by the genital pore into a shallow depression on the ventral surface of the worm. The cirrus is ·3–·38 mm. long by ·03 mm. wide. The sac is ellipsoid with its larger diameter in an antero-posterior direction, and with its posterior edge directed towards the ventral surface. Its shorter diameter is ·3–·46 mm.

The ovary is H shaped, with its isthmus and lobes lying entirely in the medulla. Its anterior lobes are larger than the posterior and may extend forwards as far as the level of the anterior margin of the cirrus sac. The isthmus is wide, the oviduct arising from it dorsally to one side of the midline. An oocapt was not observed.

The vitellaria are abundant and cortical, their distribution (on one side only) being indicated in fig. 1. Transverse sections through the middle of the uterine field show that the follicles are arranged in a single layer in the cortex outside the inner longitudinal musculature. Anteriorly to the uterus they are present only laterally. Near the posterior limit of their distribution they decrease in number and are also disposed only laterally. The most posterior follicles lie above and below the anterior ovarian lobes. Post-ovarian follicles are absent. The rounded or oval follicles measure about 90μ in diameter. Two ventral vitelline ducts formed by the union of several smaller ducts on each side join in the midline, and the common yolk duct so formed passes posteriorly, becoming swollen slightly into a yolk reservoir before joining the oviduct.

The uterus commences as a narrow tube at the junction of the oviduct and yolk duct (fig. 2), widening gradually and becoming thrown into many folds in the region behind the ovarian isthmus. The walls have also become considerably thickened, due to the presence of gland cells. This glandular uterus passes forwards above the ovary as an almost straight tube, but it becomes thrown into folds which may extend dorsally or dorso-laterally to the cirrus sac. Anterior to the latter the glandular ascending uterus may lie either dorsally or ventrally to the folds of the descending uterus. At about half the midlength of the worm the glandular portion of the uterus terminates and the uterus then becomes a wide thin-walled tube swollen with eggs and thrown into extensive folds lying on one side of the midline. After reaching the anterior limit of the uterine field (which lies at about the end of the first two fifths of the body length), the tube crosses to the other side of the median line to become again thrown into folds as it passes posteriorly. A short distance in front of the cirrus sac, the descending uterus approaches the midline and travels more or less dorsally to the sac and then curves sharply towards the ventral surface (fig. 1, 2). A short distance

before its termination it is joined by the vagina, the utero-vaginal canal thus formed opening at the genital pore adjacent to the posterior border of the cirrus sac (fig. 2). The vagina travels back dorsally to the ovary, where it enlarges to form a receptaculum seminis. It then narrows considerably to enter the lower part of the oviduct. The latter, after receiving the vagina, proceeds ventrally to meet the yolk duct, and in this region shell glands are present. Eggs measure 43 by 26μ.

Our species belongs to the Lytocestinae as defined by Hunter (1927; 1929; 1930), but differs from other members of the sub-family in many of its features. It is distinguished from *Lytocestus* (Cohn, 1908; Hunter, 1930; Woodland, 1926; Szidal, 1937) by the presence of a common genital pore, medullary ovarian lobes, and a long uterus extending into the pre-ovarian region of the worm. It differs from *Balanotaenia* (Johnston, 1924) in having an unspecialized scolex and in having uterine coils extending forwards beyond the cirrus sac. This latter feature distinguishes the new species from *Monobothrioides* (Fuhrmann and Baer, 1925) which also has a short uterus, a terminal introvert and separate genital pores. *Djombangia* (Bovien, 1926; Hunter, 1930) has a scolex with a terminal sucker and its eggs have spines. *Lytocestoides* (Baylis, 1928; Hunter, 1930) has a conical scolex, postovarian vitellaria and a relatively short uterus. We therefore erect a new genus *Notolytocestus* (southern *Lytocestus*) for its reception. The following diagnosis is suggested:

Lytocestinae; with scolex unspecialized and narrower than rest of body; cirrus opening into utero-vaginal canal as in *Caryophyllaeides* (Nybelin, 1922); vitellaria entirely cortical; ovary and its lobes medullary; uterus extending nearly to the anterior margin of the testicular field; postovarian yolk follicles absent. Type *N. major* n. sp. from the Australian freshwater Siluroid, *Tandanus tandanus.*

NOTOLYTOCESTUS MINOR n. sp.

Fig. 6–7.

A single specimen of this small Caryophyllaeid was found in the intestine of a *Tandanus tandanus* caught by Miss L. M. Angel in December, 1947, near Murray Bridge. In company with it were many *Balanotaenia bancrofti,* some *Notolytocestus major,* and a *Biacetabulum.* The worm is 6·5 mm. long by 1·7 mm. broad (fig. 6).

Because of the characters of the anterior end and the distribution of the testes and vitellaria, the worm was at first thought to be a very young specimen of *N. major* but the specimen is egg-bearing, and amongst our material of *N. major* was one which was quite devoid of eggs but which was of about the

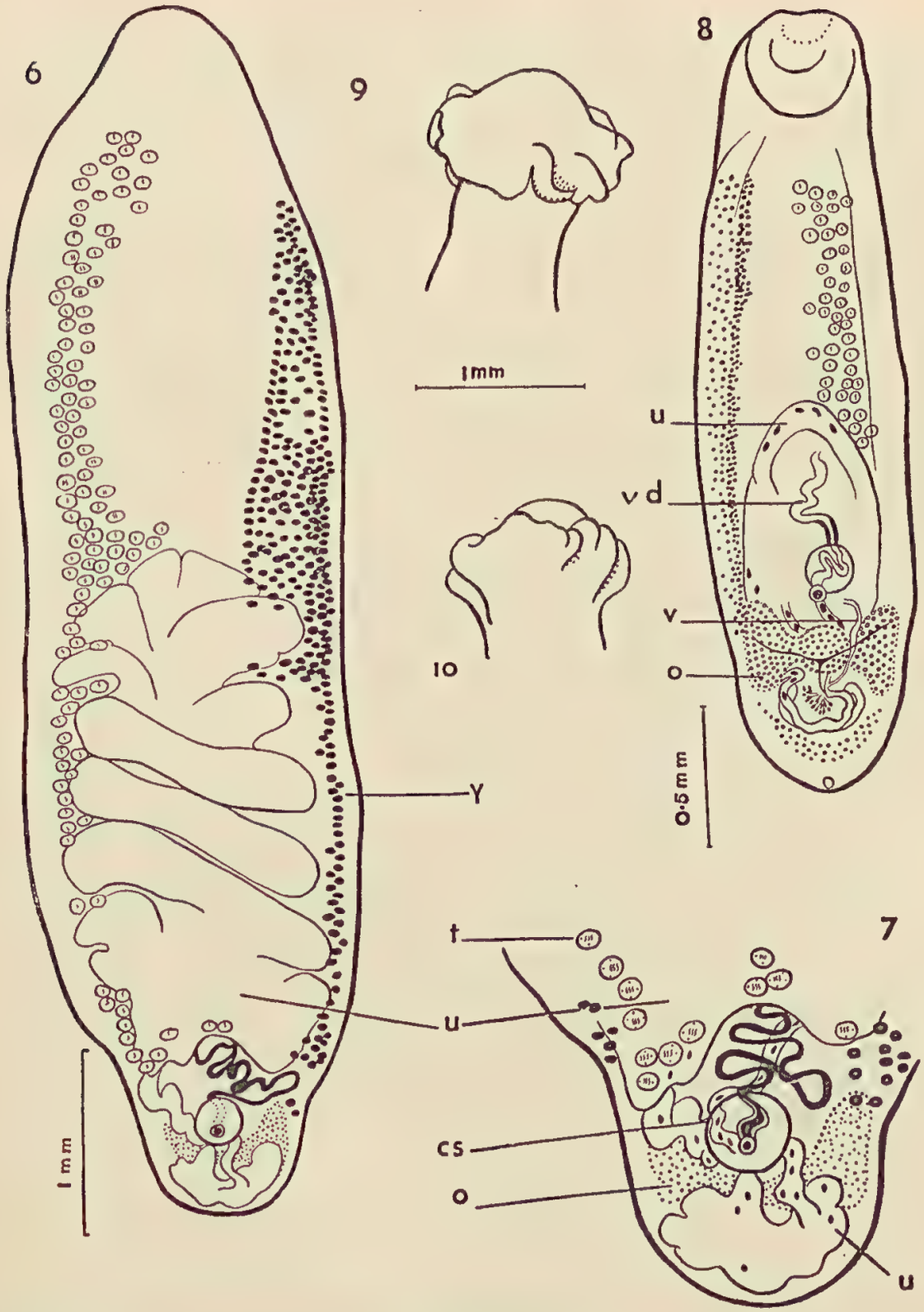


Fig. 6, 7. *Notolytocestus minor.* 6, Ventral view showing uterine field, and on one side, the distribution of the testes, on the other the vitellaria; 7, reproductive system; 8, *Biacetabulum tandani*; 9, 10, *Balanotaenia bancrofti*, ventral and dorsal views of scolex. (Figures 7 and 8 are drawn to the same scale.) Lettering as in preceding figures.

same size (11·5 mm. by 5·5 mm.) as the ovigerous worms. We think that the form now under consideration belongs to a different, but closely related, species. The eggs, testes, vitellaria and cirrus sac are all smaller than those of *N. major*.

The scolex which is not differentiated, is rounded anteriorly and narrower than the rest of the body; it widens gradually into the body. The posterior end of our specimen is contracted.

The testes are about 76μ in diameter and their field extends forwards to about one ninth of the body length from the anterior end. Their posterior limit could not be determined accurately because of the closely packed condition of the uterine folds. The vas deferens is much coiled and on one side extends laterally nearly to the margin of the body. It enters the cirrus sac on the antero-dorsal surface of the latter. On the midventral surface of the sac there is an aperture which may be either the male aperture or a common genital pore. The cirrus sac is spherical, ·23 mm. in diameter.

The vitellaria, as far as could be ascertained without studying sections, are cortical. Anteriorly they are arranged laterally but as the front limit of the uterine field is approached, they extend more toward the mid-ventral and mid-dorsal surfaces (fig. 7). They reach back as far as the wings of the ovary, and are absent from the post-ovarian region. They are rounded or oval, with an average diameter of 38μ.

Owing to the unusually great development of the uterus posteriorly, only the anterior part of the ovarian wings could be seen (fig. 7). Details regarding the post-ovarian part of uterus were not ascertainable. The uterus passes above the ovarian isthmus and cirrus sac and then becomes thrown into a mass of closely arranged folds which extend forwards to a point in front of the midlength of the worm. Only a small part of the descending uterus was recognized as such and this was seen dorsal to the cirrus sac. The uterus was densely packed with eggs averaging 39 by 20μ. The uterine pore and vagina were not recognized in the specimen.

The parasite seems to belong to *Notolytocestus* because of its anatomy (as far as is known), but we are uncertain whether the vitellaria are entirely or partly cortical.

BIACETABULUM TANDANI n. sp.

Fig. 8.

This minute mature cestode measures 2·1 mm. in length by 0·5 mm. in width. The body has rounded extremities, the scolex bearing two acetabula, one on the dorsal and one on the ventral surface. There is no neck, the scolex merging into the body without any marked alteration in breadth (fig. 8). There is a

terminal excretory pore. Six large excretory canals could be counted in the region in front of the uterus. One of these, on each side, could be traced as far back as the region of the ovary.

The oval testes measure 24–34μ in their shorter diameter and extend forwards to a region about one fifth of the body length from the anterior end. Posteriorly they reach almost the level of the cirrus sac where they can be detected only laterally because the uterus occupies most of the body in this region. The vas deferens is wide, and just before entering the rounded cirrus sac (114μ in diameter) on its antero-dorsal border, it passes into a thick-walled external vesicula seminalis. On leaving the latter the vas narrows to enter the cirrus sac. The cirrus opens into the utero-vaginal canal which terminates at the genital pore lying ventrally to the posterior edge of the cirrus sac. The genital aperture lies at a point three fourths of the body length from the anterior end.

The ovary is H shaped, the anterior points of the two wings almost reaching the level of the cirrus sac. The isthmus in dorso-ventral view is circular, forming an ovarian reservoir as described by Hunter (1927) for *Biacetabulum infrequens* and *Caryophyllaeus terebrans* Linton.

The uterus extends forwards almost to the midlength of the body and, in the single specimen studied, is packed with eggs except in the post-ovarian portion of the duct. The latter region of the uterus, the beginning of which is surrounded by shell glands, is thrown into a number of loops. It passes forwards until it lies about 0·5 mm. in front of the cirrus sac. The descending limb travels back to reach the level of the ovary before turning forwards to terminate at the genital pore. The vagina travels forwards on one side of the oviduct and then bends towards the midline to meet the uterus. At about the level of the anterior border of the ovarian isthmus an elongate receptaculum seminis is formed. The average size of eggs is 48 by 28μ.

The vitellaria appear to be medullary in position. They are distributed laterally and extend forwards almost as far as the testes, and posteriorly as far as the ovary. There is a group of post-ovarian yolk glands. The follicles measure 6–8μ in diameter. Two yolk ducts join to form a median vitelline duct, but the duct from the post-ovarian group was not observed.

The anatomy, as far as the study of a single specimen has permitted, indicates that the worm belongs to the Caryophyllaeinae because of the position of the sex apertures in the last quarter of the body length and the probable medullary position of the vitellaria. The presence of uterine glands was not established. Our species exhibits many of the characters of *Biacetabulum*. Although it does not possess a well defined scolex, two sucker-like depressions were observed. It resembles *Biacetabulum* in the relationship of the sex aper-

tures, the shape of the ovary, the anterior extent of the uterine field, as well as the presence of an external seminal vesicle and post-ovarian vitellaria. It differs from all previously described species of that genus in its smaller size, absence of neck region and well-marked loculi, and in the smaller size of the testes, vitellaria and cirrus sac. *B. tandani* is the first member of the Caryophyllaeinae to be recorded from Australia.

LITERATURE.

Baylis, H. A. (1928) : *Ann. Mag. Nat. Hist.*, (10), 1, pp. 552–562.

Bovien, V. (1926) : *Vidensk. Med. Dansk. Naturh. Foren.*, 82, pp. 167–181.

Fuhrmann, O. (1928–33) : Cestoidea in Willy and Kukenthal, Handb. d. Zool., 2, (1), pp. 141–416.

Fuhrmann, O. and Baer, J. G. (1925) : *P.Z.S.* 1925, pp. 79–100.

Hunter, G. W. (1927) : *Jour. Parasit.*, 14, pp. 16–26.

Hunter, G. W. (1929) : *Jour. Parasit.*, 15, pp. 185–192.

Hunter, G. W. (1930) : Studies on the Caryophyllaeidae of North America. *Illinois Biol. Monog.*, 11 (4), Oct. 1927 (May 1930), 186 pp.

Johnston, T. H. (1924) : *Pr. Linn. Soc., N. S. Wales*, 49, pp. 339–347.

Nybelin, O. (1922) : *Gotebergs Kgl. Vet. Vitt. Samh. Handl.*, 26 (1), pp. 1–228.

Szidat, L. (1937) : Z. f. *Parasitenk.*, 9, pp. 771–786.

Woodland, W. N. F. (1923) : *Q.J.M.S.*, 67, pp. 435–472.

Woodland, W. N. F. (1926) : *P.Z.S.*, 1926, pp. 49–69.

FAUNA AND FLORA OF THE GREENLY ISLANDS, PART II

THE FLORA

BY J. B. CLELAND.

THE Greenly Islands were visited in December, 1947, by four members of the Adelaide Bush Walkers accompanied by F. J. Mitchell of the South Australian Museum staff. A survey was made of the Natural History of these islands which are situated in lat. 34° 38′ S. and long. 134° 37′ E., this being approximately twenty-five miles from the nearest point on Eyre Peninsula, South Australia. The "Introductory Narrative and Vertebrate Fauna" by J. F. Mitchell and A. C. Behrndt appeared in these "Records" Vol. ix, pp. 167–179.

The plants were collected assiduously with notes on the localities, and the specimens taken probably represent, with the exception perhaps of a few ephemerals, the present total flora of the Island. Most of the fifty-one species collected were in flower. Fifty of these plants are natives of Australia, and only one, the common Sow Thistle, is an introduced species. The seed of the latter can so readily be air-borne that its lodgement on the Island was only to be expected.

It is of interest to speculate as to how these various plants come to be present now on this rather isolated group of islands. They consist of species which are to be found on similar maritime situations on the mainland and on Kangaroo Island; in fact, hardly any other plants could survive in such an exposed situation. Some probably represent part of the original population that was present when the Greenly Islands were separated from the mainland, just as we have on Kangaroo Island some representatives of Western Australian species of plants which have survived there. Probably the *Casuarina, Exocarpus, Correa, Dodonaea, Frankenia, Melaleuca, Calythrix, Leucopogon* and others are species which have so survived. The plants with plumose seeds, such as many of the *Compositae* and especially the Sow Thistle, have a ready means of transport, and over thousands of years seeds of various species must have been blown on to the Islands, especially during north winds. Only such as could withstand the rigorous conditions would survive. The presence of the fruit-eating Silver-eye (*Zosterops lateralis*) and the seed-eating Rock Parrot (*Neophema petrophila*) indicate how the *Leucopogon* and the *Myoporum* and the two species of *Calandrinia* may have arrived. Plants with very small seeds, such as the *Calandrinias* just mentioned, whose seeds measure $\frac{1}{2}$ to $\frac{3}{4}$ mm. and are produced in abundance,

might alternatively have reached their destination by being caught up in dust storms and whirlwinds and transported a considerable distance. Species accustomed to a salt marsh habitat or sea-spray, such as the *Plagianthus* and Sea Celery, might have reached the Island as sea-borne fruits. White men have visited the Islands from time to time and the Sow Thistle may have been introduced by them and it is just possible that seeds of other plants may have been carried over during the present visit in spite of special efforts to prevent such.

The following species were obtained: FILICALES: *Cheilanthes tenuifolia.* On Sheoak Ridge at 500 to 600 feet. SCHEUCHZERIACEAE: *Triglochin centrocarpa.* Only growing at the brackish water seeps. GRAMINEAE: *Stipa elegantissima.* On Anthoney Island near top. Growing in one small clump only. *Agrostis Billardieri.* Growing in a grassy niche south of West Point. *Distichlis distichophylla.* Growing on Anthoney Island in a dense mat; it appeared to have exuded moisture on it. *Poa poaeformis.* Fairly abundant near the summit of main island. *Puccinellia stricta.* Also a grass, not identified. CYPERACEAE: *Scirpus nodosus.* LILIACEAE: *Dianella revoluta.* Growing in groups south of West Point. *Bulbine semibarbata.* On Sheoak Ridge at 500 feet. CASUARINACEAE: *Casuarina stricta,* Sheoak. URTICACEAE: *Parietaria debilis.* Growing on the summit of the main island to windward in *Casuarina* and *Melaleuca* scrub. SANTALACEAE: *Exocarpus aphyllus* or *E. strictus,* a "Native Cherry." Up to three feet high. Only one bush found at 500 feet on Anthoney Island and none elsewhere. POLYGONACEAE: *Muehlenbeckia adpressa.* CHENOPODIACEAE: *Rhagodia crassifolia.* Very plentiful with red berries. *Atriplex paludosum. Atriplex muelleri?* (not in flower). Restricted to the eastern slopes of Anthoney Island. *Salicornia australis* probably, a samphire. AIZOACEAE: *Tetragonia implexicoma.* A slender creeper with small, yellow flowers; growing among the saltbushes on east side of the main island at 200 feet. PORTULACACEAE: *Calandrinia volubilis* and *C. calyptrata.* It is interesting that these two species of little succulents with their purple flowers are found on the Greenly Islands; they are alike, but the size, colour and markings of the seeds readily distinguish them. Plentiful on Anthoney Island. CRUCIFERAE: *Lepidium foliosum.* CRASSULACEAE: *Crassula Sieberiana.* GERANIACEAE: *Pelargonium australe.* OXALIDACEAE: *Oxalis corniculata.* Restricted to the summit of Anthoney Island. RUTACEAE: *Correa rubra* This scented plant whose leaves turn red is very plentiful and it is frequented by butterflies. SAPINDACEAE: *Dodonaea viscosa.* Found on Anthoney Island at 400 feet as a procumbent, thick shrub, 3 feet high and 12 feet in diameter. MALVACEAE: *Plagianthus microphyllus.* FRANKENIACEAE: *Frankenia pauciflora,* var. *longifolia.* A soft, creeping bush, less than 1 foot high; growing on West Point. THYMELAEACEAE: *Pimelea serpyllifolia.* Not very common; only a dozen bushes

being seen at 400 to 500 feet; up to 18 inches high. MYRTACEAE: *Melaleuca pubescens,* Black Tea-tree. *Calythrix tetragona.* As a low, spreading, procumbent, light green shrub about 1 foot high, growing on West Point. UMBELLIFERAE: *Didiscus pusillus,* a very robust form. *Apium australe,* Sea Celery. EPACRIDACEAE: *Leucopogon parviflorus,* in flower and fruit, two low poor bushes only, at 400 to 500 feet. PRIMULACEAE: *Samolus repens.* GENTIANACEAE: *Erythraea australis.* From 300 feet to the summit at West Point. SCROPHULARIACEAE: *Euphrasia collina.* A succulent maritime form. West Point. MYOPORACEAE: *Myoporum insulare,* Blueberry Tree or Native Juniper. RUBIACEAE: *Galium australe.* COMPOSITAE: *Brachycome ciliaris.* This plant is abundant at all levels on Anthoney Island. The flowers are white and yellow. *Olearia axillaris.* Plentiful on all levels on all the Islands. *Cotula coronopifolia.* On Anthoney Island at 200 to 300 feet. *Senecio lautus.* Abundant on Anthoney Island; specimens found in sheltered shade are more robust than others. *Gnaphalium japonicum.* Found on Anthoney Island, but not abundant; it is very scarce on the main island. Only depauperate plants seen. *Ixiolaena supina.* Abundant on Anthoney Island but scarce on the main island; sweet scented and bushy, often covering rocks. *Helichrysum bracteatum.* On the top of Anthoney Island at summit. *Podolepis rugata.* Growing about 1 foot high with succulent leaves. Large areas at West Point. *Calocephalus Brownii,* Snow-bush. *Sonchus oleraceus,* Sow Thistle. In a niche at West Point.

Nicotiana sp. (Solanaceae) was identified by Miss C. Eardley in a small collection of plants made by Mr. H. H. Finlayson in November, 1947.

PLEISTOCENE LAND AND FRESH WATER SHELLS FROM SOUTH AUSTRALIA

By BERNARD C. COTTON, Conchologist, South Australian Museum.

The living native snail *Meracamelon cassandra* Pfeiffer 1864 occurs alive and in number on the Murray River Cliffs. It has been taken at numerous places along the River, Blanchetown, Swan Reach, Mannum, Murray Bridge and Tailem Bend. Two fossil specimens of probably Pleistocene age are in the South Australian Museum collection labelled "*Helix cassandra,* from a railway cutting east of Murray Bridge in clay about 12 feet from the surface. March 1886." The height of this site is about 70 feet above sea level. In February, 1950, Mr. J. E. Caldrake of the C.S.I.R.O. and I examined a site in a railway cutting four and a half miles south of Keith. Here odd specimens of *Meracamelon cassandra* are embedded in a very hard sandstone at about 150 feet above sea level and 18 feet below the surface. Above the sandstone is a bed of clay which may contain specimens. On Col. D. Fulton's property at Emu Flat three miles east of Keith, a similar sandstone was examined. It had been taken from a well, where it lay above the water bearing Miocene shell bed, which is struck at a depth of about 80 feet in this locality. This is the first record of a Pleistocene fossil land shell being found in South Australia. A Pleistocene fresh-water shell *Notopala wanjakalda* was recorded by the writer (Rec. S. Aust. Mus., 5, No. 3, 1935) from the banks of the Murray at Sunnyside and it is also found at a site close to the one mentioned above in the railway cutting near Murray Bridge, where the fossil *M. cassandra* is found. *M. cassandra* lives only along a corridor defined by the River Murray and only on the tertiary limestone cliffs which flank either side. The presence of the Pleistocene *Meracamelon* suggests the probability that the Murray River may have passed through this area in the past.

AUSTRALIAN CUMACEA. No. 17[1]

The FAMILY DIASTYLIDAE (Cont.)[2]

By HERBERT M. HALE, Director, South Australian Museum.

Fig. 1–10.

The few Diastylids herein dealt with are from Western Australia. Four species have been recorded from the Indian Ocean coast; eleven are added, together with two (*Gynodiastylis vicaria* and *Dicoides occidentalis* spp. nov.) from the south coast.

The Diastylids which can be listed now for Western Australia are:

Leptostylis vercoi Hale.
Paradiastylis mollis Hale.
Paradiastylis whitleyi sp. nov.
Dimorphostylis australis Foxon
Dimorphostylis cottoni Hale.
Dimorphostylis vieta Hale.
Anchistylis waitei (Hale).
Gynodiastylis hartmeyeri Zimmer.
Gynodiastylis similis Zimmer.
Gynodiastylis bicristata Calman.
Gynodiastylis lata Hale.
Gynodiastylis turgida Hale.
Gynodiastylis munda sp. nov.
Gynodiastylis vicaria sp. nov.
Gynodiastylis inepta sp. nov.
Dicoides occidentalis sp. nov.
Zimmeriana lasiodactyla (Zimmer).

As with the Australian species of *Campylaspis*, very few species of *Gynodiastylis* and related genera have hitherto been taken by submarine light, perhaps because this method of collecting is almost untried on the silt grounds off New South Wales, where these genera are well represented. The Diastylids dealt with below were all attracted to submarine lights operated by Dr. A. G. Nicholls and Mr. G. P. Whitley.

Genus Paradiastylis Calman 1904.

Paradiastylis mollis Hale.

Paradiastylis mollis Hale, 1945, p. 177, fig. 3–4.

This delicate species is apparently a northerly form insofar as Australia is concerned. It was described from the eastern coast, lat. 27.28 S.; G. P. Whitley, by means of a submarine light, Aug.–Dec., 1945, later secured females and

1 For No. 16 see *Rec. S. Aust. Mus.*, ix, 1949, pp. 225–245, fig. 1–12.

2 See also *Trans. Roy. Soc., S. Aust.*, 69 (2), 1945, pp. 173–211, fig. 1–26 and *Rec. S. Aust Mus.*, viii, 1946, pp. 357–444, fig. 1–60.

juveniles from five localities on the northern part of the coast of Western Australia, ranging from Dampier Archipelago (20.27 S.) to Geraldton (28.45 S.).

P. mollis resembles *brachyura* Calman (1904, p. 174, pl. v, fig. 76–90 and Hale, 1945, p. 177). Zimmer examined a much damaged female *Paradiastylis* from the Swan River, Western Australia and stated that it was allied to *brachyura* (see Zimmer, 1914, p. 187).

PARADIASTYLIS WHITLEYI sp. nov.

Adult male. Integument membranous, shining, semi-transparent.

Carapace with shallow pitting but no apparent ridges; it is barely wider than deep and is about twice as long as greatest breadth, which occurs about

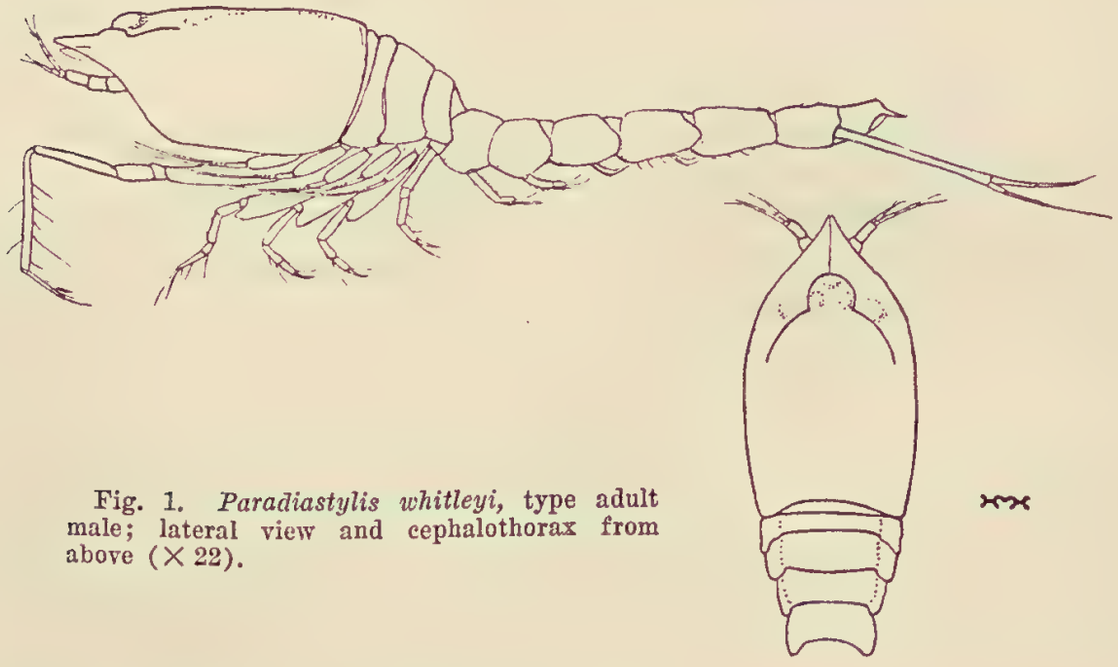


Fig. 1. *Paradiastylis whitleyi,* type adult male; lateral view and cephalothorax from above (× 22).

region of ocular lobe; it is considerably more than one-third of total length and twice as long as pedigerous somites together. Pseudorostrum one-fifth of length of carapace, acute in front. Ocular lobe large, a little wider than long and with tumid unpigmented lenses. No defined antero-lateral angle.

Pleon barely longer than cephalothorax; fifth somite nearly twice as long as wide and one-fifth as long again as either fourth or sixth, the latter somewhat dilated posteriorly; telson subcordate, with marked U-shaped dorsal depression; the very narrow post-anal part has a pair of apical spines and two pairs of lateral spines.

Third segment of first antenna more than half as long again as second; flagellum four-jointed, the second segment longest, and as long as second and third peduncular segments together; accessory lash four-jointed, the last segment minute, the third the longest.

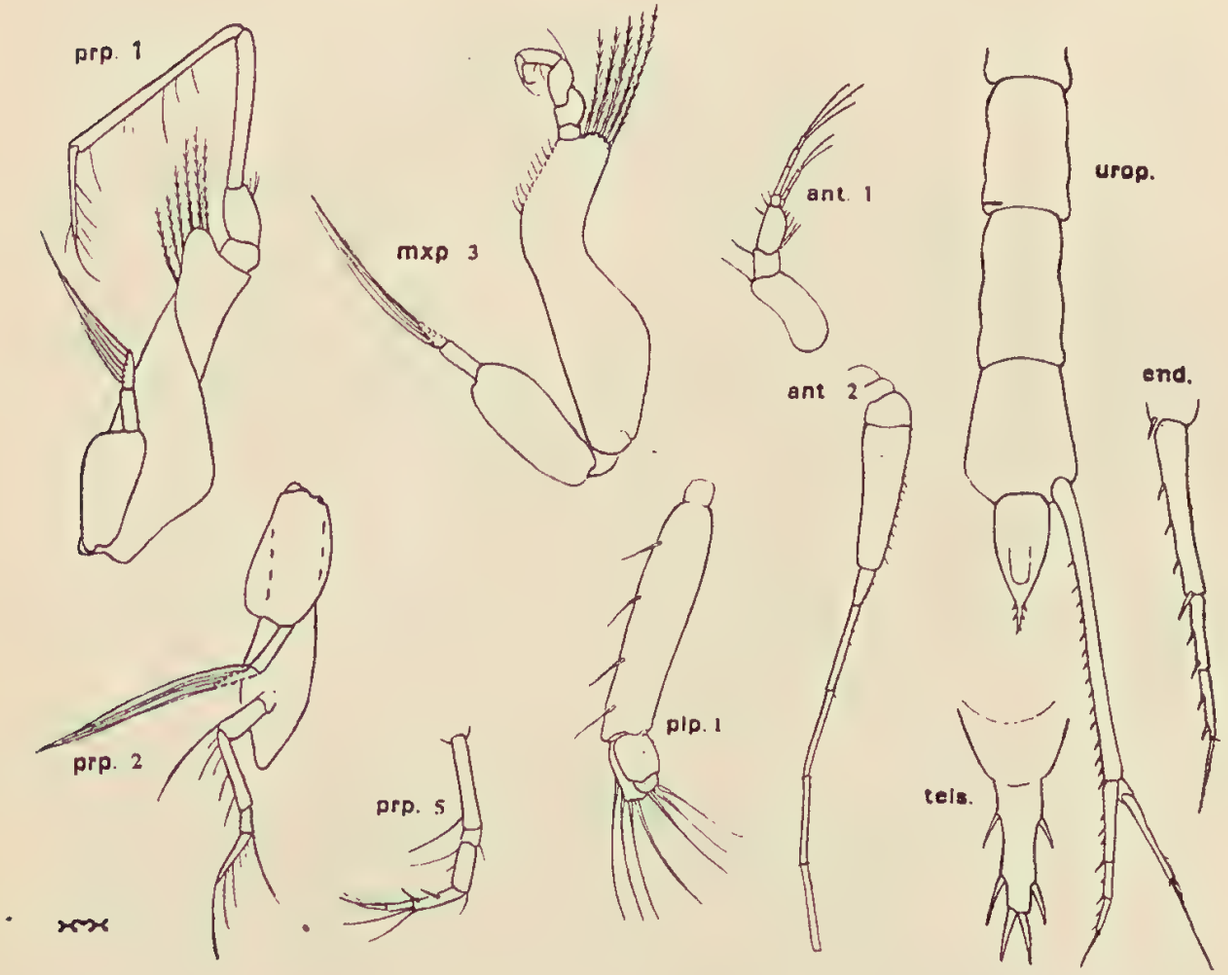


Fig. 2. *Paradiastylis whitleyi*, paratype adult male; ant. 1–2, first and second antennae; mxp. 3, third maxilliped; prp. 1, 2 and 5, first, second and fifth peraeopods; plp. 1, first pleopod; urop., uropod with fourth to sixth pleon somites and telson (all × 40); tels., distal end of telson (× 160); end., endopod of uropod (× 80).

Second antenna with flagellum reaching beyond distal end of peduncle of uropods; flagellum with very long joints (fig. 2, ant. 2).

Basis of third maxilliped more than twice as long as remaining joints together.

First peraeopod elongate, the carpus reaching to level of tip of pseudorostrum; basis about two-thirds as long as rest of limb; propodus barely one-third as long again as carpus and more than twice as long as dactylus.

Basis of second peraeopod longer than rest of limb; carpus as long as propodus and dactylus together and more than half as long again as merus.

Propodal and carpal setae of posterior peraeopods reaching to or barely beyond tip of dactylus.

Pleopods with endopod two-jointed and exopod undivided.

Uropod with peduncle more than twice as long as telson and armed on inner margin with fifteen spines; endopod (without terminal spine) half as long as peduncle and more than one-third as long again as exopod; it is three-jointed, the first segment fully twice as long as second, which is one-fourth as long again as third; the inner spines of the endopodal joints are four, two and two, and the terminal spine is as long as the third joint and much shorter than the longest terminal spine of exopod.

Length 4·0 mm.

Loc. Western Australia: Shark Bay, South Passage, 1½ fathoms, on sand (G. P. Whitley, ex cutter "Isobel," submarine light, Nov., 1945, temperature, 21·84° C.); Shark Bay, North end of Herald Bight, 3 fathoms, on sand (G. P. Whitley, ex cutter "Isobel," submarine light, Nov., 1945, temperature 24·22° C.). Houtman Abrolhos, Turtle Bay, East Wallabi Is., 2 fathoms, on sand (type loc., G. P. Whitley, ex cutter "Isobel," submarine light, Dec., 1945, temperature 21·70° C.). Type male in South Australian Museum, Reg. No. C. 3226.

Males only are available. The size varies little but some examples are just under 4 mm. in length. In the uropod the armature of the peduncle and first joint of the endopod is variable, there being sometimes seventeen spines on the inner margin of the peduncle and seven on the first endopodal joint. At Herald Bight in Shark Bay the species was taken in company with *Dimorphostylis australis.*

Admitting the species included by the writer (Hale, 1945, p. 179, *et. seq.*), *Dimorphostylis* is separable from *Paradiastylis* by a single female character and the species described above is placed tentatively in the older genus. In the latter it falls closest to *P. longipes* Calman (1905, p. 21, fig. 4); it differs in the absence of lateral ridges on the carapace and in the proportions of the uropods, in which the first joint of the endopod is longer than the second and third joints together, instead of about three-fourths of this length, as shown in Calman's fig. 41; in a single male recorded from New South Wales as *P. longipes* (Hale, 1945, p. 177) the first joint of the endopod is two-thirds as long as combined lengths of second and third joints.

If this Western Australian species proves to belong to *Dimorphostylis* (in

which the third maxilliped of the female does not lack the exopod as in *Paradiastylis*) it most nearly resembles *D. cottoni* Hale, but lacks the lateral ridges of the carapace present in that species, in which also the first and second peraeopods are of different proportions and the first joint of the endopod is relatively much longer.

Genus DIMORPHOSTYLIS Zimmer 1921.

DIMORPHOSTYLIS AUSTRALIS Foxon.

Dimorphostylis australis Foxon, 1932, p. 390, fig. 7–8; Hale, 1945, p. 180, fig. 5–6 (male only).

On the evidence of the collecting carried out in Australian waters to date it would seem that this is a tropic species. Some specimens now in hand were taken by G. P. Whitley (submarine light, Nov., 1945) at four localities in Shark Bay, Western Australia, lat. 25.30 S., while on the east coast of Australia *D. australis* is known to occur only a little further to the south, but north to Low Isles, Queensland.

Foxon's specimens were preserved in formalin and consequently were in bad condition when examined by him. A series taken at Broadhurst Bight, Shark Bay, by Whitley comprises over one hundred adult males and three ovigerous females, so that the description of the last-named sex may now be supplemented.

Ovigerous female. Carapace one-third of total length of animal and more than twice as long as pedigerous somites together.

Pleon longer than cephalothorax by about one-third of length of telson; telson almost half as long as rest of pleon, and with short terminal spines as in male.

Third segment of peduncle of first antenna nearly half as long again as second.

First peraeopod with carpus reaching to level of tip of pseudorostrum; propodus about one-fourth as long again as carpus and more than twice as long as dactylus.

Peduncle of uropod about one-fourth as long again as telson, with much fewer spines (less than ten) than in male; first joint of endopod little longer than second and third joints together; inner spines of endopod two plus one plus one.

Length 4·1 mm. Ova 0·15 mm.

DIMORPHOSTYLIS COTTONI Hale.

Dimorphostylis cottoni Hale, 1936, p. 400, fig. 5–6 and 1945, p. 197, fig. 17–18.

This species was previously recorded from southern and eastern Australia, north to lat. 32.0 S.; specimens have since been collected by A. G. Nicholls in Western Australia at Esperance Bay (south coast) and Garden Island on the west coast (lat. 32.8 S.). It is not represented in any of the collections made further north.

DIMORPHOSTYLIS VIETA Hale.

Pachystylis vieta Hale, 1936a, p. 424, fig. 14–15 and 1937, p. 72.

Dimorphystylis vieta Hale, 1945, p. 192, fig. 13–14.

A single female was taken by G. P. Whitley at Garden Island, Western Australia, thus extending the known distribution of this easily recognized form.

Genus ANCHISTYLIS Hale 1945.

ANCHISTYLIS WAITEI Hale.

Anchicolorus waitei Hale, 1928, p. 45, fig. 15–16 and 1936, p. 418.

Colurostylis waitei Zimmer, 1930, p. 651.

Anchistylis waitei Hale, 1945, p. 204, fig. 21–22 and 24.

Specimens have been collected by A. G. Nicholls and G. P. Whitley from a number of Western Australian localities—Esperance Bay on the south coast and on the western shores at Garden and Rottnest Islands, and at Houtman Abrolhos.

In this series both adult males and ovigerous females vary in total length from 2·5–4 mm., the size having no apparent relation to locality; it should be mentioned, however, that all material was secured by submarine light.

The species was known previously only from the southern coasts of Australia.

Genus GYNODIASTYLIS Calman 1911.

GYNODIASTYLIS BICRISTATA Calman.

Gynodiastylis bicristata Calman, 1911, p. 374, pl. XXXVI, fig. 11–22.

Calman's types were from the Gulf of Siam and Japan. Two ovigerous females and a male taken by G. P. Whitley on the eastern shore of North-West Cape, Western Australia, are referred here.

They are somewhat smaller than Calman's specimens, the male being 1·45 mm. in length, the females 1·6 mm.

GYNODIASTYLIS LATA Hale.

Gynodiastylis lata Hale, 1946, p. 366, fig. 5–6.

The type series was taken at Moreton Bay, Queensland. G. P. Whitley secured a single example at the Mary Anne Group, North-Western Australia, in 3½ fathoms.

GYNODIASTYLIS TURGIDA Hale.

Gynodiastylis turgida Hale, 1928, p. 42, fig. 11–12 and 1936, p. 420, fig. 10–11.

A single male was taken by A. G. Nicholls at Careening Bay, Garden Island, Western Australia, in 3 fathoms by submarine light. The species was formerly recorded only from South Australia.

GYNODIASTYLIS HARTMEYERI Zimmer.

Gynodiastylis hartmeyeri Zimmer, 1914, p. 187, fig. 14.

The type locality is Shark Bay, Western Australia. A subadult female, 1·7 mm. in length, was collected by G. P. Whitley at Airlie Island, off Onslow (submarine light, 3 fathoms, rock, coral and sand bottom, Sept., 1945). In this example the first peraeopod is a little longer than indicated in Zimmer's figure, the carpus reaching to level of apex of pseudorostrum.

As shown in Zimmer's fig. 14c, the distal half of the telson is subtriangular as seen from above, not rounded as in the related *similis*.

GYNODIASTYLIS MUNDA sp. nov.

Female with developing marsupium. Integument fragile, dull opaque; sides of carapace and pedigerous somites with faintly marked large reticulate patterning.

Carapace less than one-third of total length of animal, subtriangular in shape when viewed from above, wider than deep, its proximal breadth being not much less than its length; back with a finely crenulate longitudinal ridge on each side, extending from tip of pseudorostral lobe almost to hinder margin, where it is connected with its fellow by a low transverse ridge; dorsum between carinae slightly convex; the sides are almost flat but not at all concave. Antero-lateral margin a little concave; antennal angle prominent, subacute and armed with one or two denticles.

Pseudorostrum narrowly truncate in front, the lobes meeting for a distance equal to two-ninths of length of carapace. Frontal lobe large; ocular lobe short and wide (four times as broad as long) and with no apparent eyes.

Pedigerous somites together four-fifths as long as carapace; pleural parts of all exposed, those of third greatly expanded fore and aft, generously overlapping second somite in front; dorsal length of fourth greater than in any of the others, and in fact equal to dorsal length of first three somites together; each of the second to fifth somites bears a pair of longitudinal dorsal carinae.

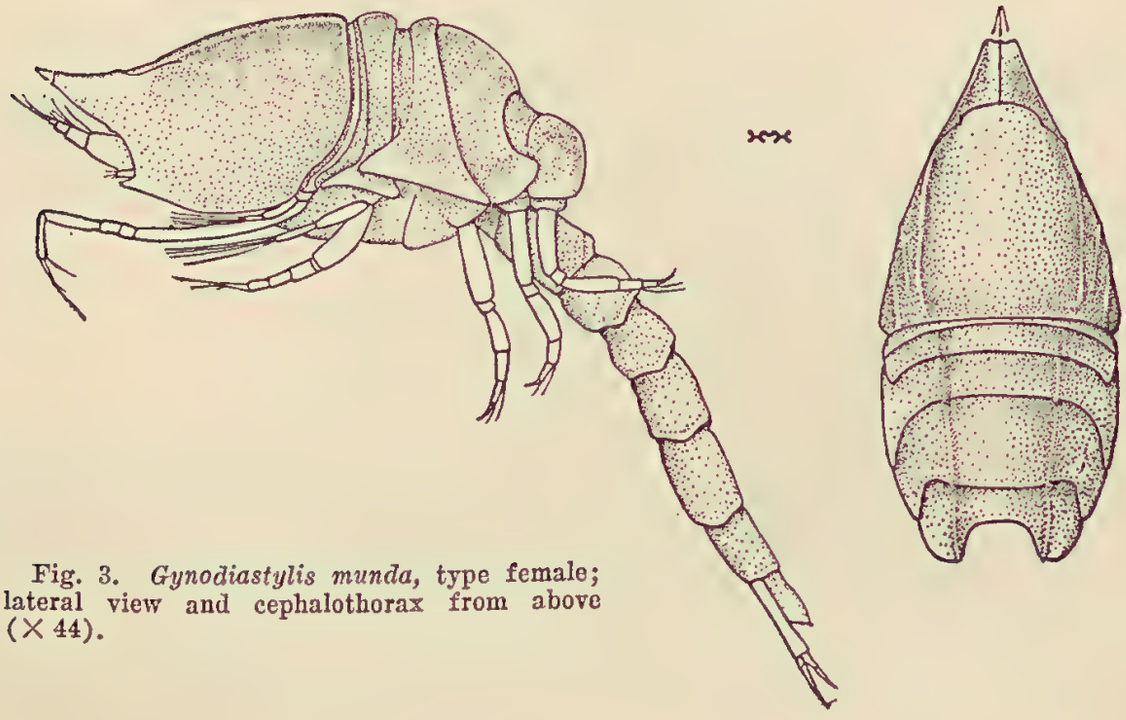


Fig. 3. *Gynodiastylis munda*, type female; lateral view and cephalothorax from above (× 44).

Pleon not quite as long as cephalothorax; first to fourth and sixth somites subequal in length; fifth somite distinctly less than half as long again as sixth, which is more than one-third as wide again as long, not greatly widened posteriorly; telson about three-fourths as long as sixth somite, subcordate as seen from above, its post-anal part very short and with a pair of tiny, stout terminal spines, flanked on one side by a short bristle (fig. 4, tels.).

First antenna with peduncle unusually large for the genus, and flagella very short; first joint of peduncle almost globose and longer than the rest of the appendage; although prominent when the animal is seen from the side, the antennae are not visible in dorsal view.

First peraeopod slender, with carpus reaching to level of tip of pseudorostrum; basis not much shorter than remaining joints together; propodus about

two-thirds as long as carpus, one-third as long again as dactylus, and about as long as its single distal seta; dactylus with a terminal seta as long as that of propodus; the exopod is small and, not including setae, only half as long as basis.

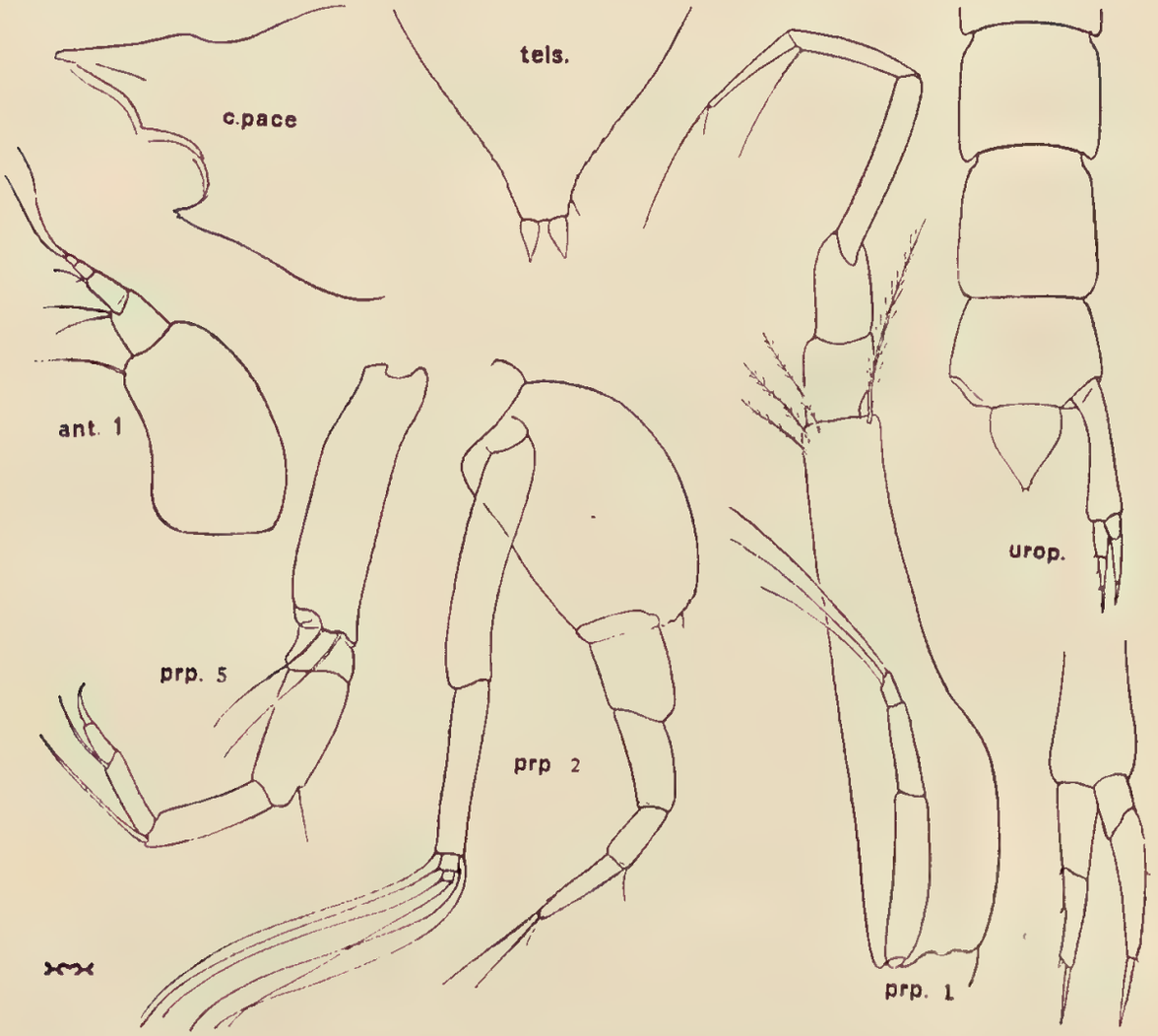


Fig. 4. *Gynodiastylis munda*, type female; c. pace, anterior part of carapace (× 70); ant. 1, first antenna (× 160): prp. 1, 2 and 5, first second and fifth peraeopods (× 160); urop., uropod with fourth to sixth pleon somites and telson (× 70; rami of uropod, × 160); tels., distal end of telson (× 420).

Second peraeopod with basis wide (breadth equal to two-thirds of length) and little more than three-fourths as long as remaining joints together; ischium distinct; merus, carpus and dactylus subequal in length, and propodus three-fourths as long as dactylus; exopod large, its peduncle and flagellum together as long as first four joints of the limb.

Basis in posterior peraeopods shorter than rest of limb; merus not much

longer than carpus, the distal seta of which does not reach to tip of dactylus; propodal seta reaching almost to tip of dactylus, which is about as long as propodus.

Peduncle of uropod a little longer than telson and more than three-fourths as long again as the rami (exclusive of terminal spines); endopod barely longer than exopod, and divided into two segments of equal length, the inner margin of the first joint bearing a single minute spine at distal end, that of second a similar spine at middle of length and another alongside the stout terminal spine, which is less than one-third as long as the ramus; exopod with similar stout terminal spine.

Colour white. Length 2·5 mm.

Loc. Western Australia, Rottnest Island, 2¼ fathoms (A. G. Nicholls, submarine light, Nov., 1945). Type in South Australian Museum, Reg. No. C.3249.

This species resembles *concava* Hale (1946, p. 416, fig. 43–44) in some respects, but is easily separated by the following features. The sides of the carapace are flat but not concave, the pseudorostrum is not acute in front, while the dorsal ridges are subparallel, instead of divergent, and extend to the tip of the pseudorostrum. The sixth pleon somite is wider and the minute armature of the posterior end of the telson is different. The first antennae are much more massive. The second peraeopod has the terminal segments less abbreviated, the ischium is distinct and the exopod is much larger. In the uropod the endopod is divided into two equal joints as in *concava*, but the peduncle is relatively longer.

GYNODIASTYLIS VICARIA sp. nov.

Adult male. Integument semi-transparent, not much calcified and not brittle.

Carapace one-third of total length of animal, twice as long as pedigerous somites together, nearly twice as long as deep and barely wider than deep; on each side is a shallow depression, the lower edge of which is raised, forming the greater part of the lateral outline when the carapace is viewed from above. Pseudorostral lobes, as seen from the side, obliquely truncate in front; they meet above for a distance equal to one-fifth of length of carapace. Frontal and ocular lobes large, the latter twice as wide as long, with large eye lenses. Respiratory siphons slender.

Pedigerous somites all exposed, not at all crowded. Pleon as long as cephalothorax; sixth somite dilated at rear, where it is a little wider than long; telson equal in length to sixth somite and with a pair of slender apical spines.

Flagella of first antenna each three-jointed; the accessory lash is not much shorter than the main one, which is longer than second joint of peduncle. Second antenna with flagellum shorter than last segment of peduncle, seven-jointed and reaching only to middle of length of pedigerous somites.

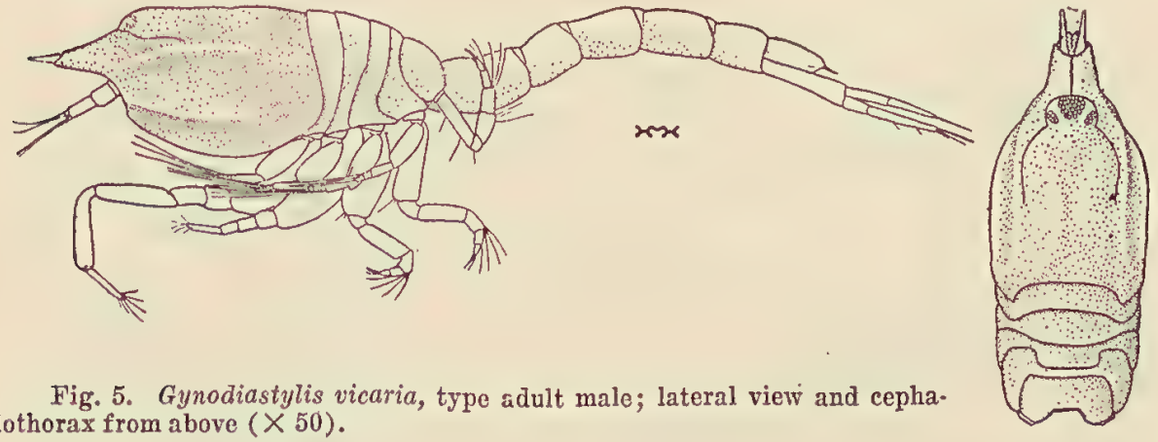


Fig. 5. *Gynodiastylis vicaria*, type adult male; lateral view and cephalothorax from above (× 50).

Exopods are present on the third maxilliped and first four pairs of peraeopods.

First peraeopod with basis more than half as long as rest of limb; propodus little longer than carpus, three-fifths as long as basis and with two insignificant distal setae; dactylus about half as long as carpus.

Second peraeopod with basis subequal in length to rest of limbs; merus, carpus and propodus all of about the same length, each two-thirds as long as dactylus.

Third to fifth peraeopods with merus as long as carpus, propodus and dactylus together; carpus with three slender distal setae, reaching to tip of the dactylus, the claw of which is slender.

Peduncle of uropod half as long again as telson; endopod, not including terminal spine, almost as long as peduncle, very little shorter than exopod, and with the first of its two segments a little shorter than second; the first endopodal joint has three spines on inner margin, the second four.

Length: 1·77 mm.

Loc. Western Australia: Esperance Bay (A. G. Nicholls, submarine light, Jan. 1946). Type in South Australian Museum, Reg. No. C. 3224.

In some respects this species is not typical of *Gynodiastylis*. The basis of the first peraeopod is relatively short for the genus, while in the propodus of this limb the distal setae are unusually short. It differs from *Zimmeriana* Hale, however, in the structure of the dactylus of the first leg, while in *Dicoides* Hale the anterior peraeopod is more massive. The female will show

whether or not the species is correctly referred. In *Gynodiastylis* it comes closest to *tumida* Hale but in the first peraeopod of *vicaria* the carpus is not shorter than the propodus and in the second is subequal in length to the propodus, instead of more than twice as long as it. Further, the proportions of the

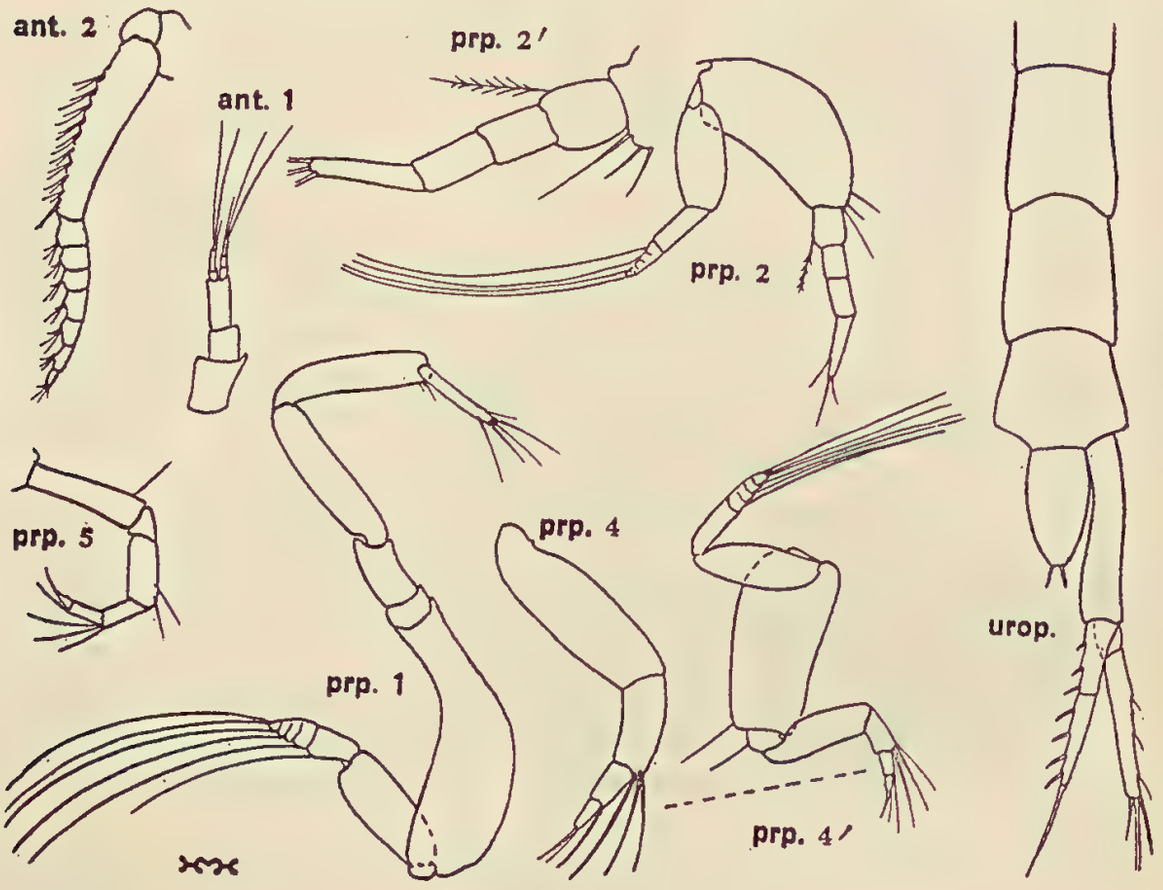


Fig. 6. *Gynodiastylis vicaria*, type adult male; ant. 1–2, first and second antennae; prp. 1, 2, 4′ and 5, first, second, fourth and fifth peraeopods; urop., uropod with fourth to sixth pleon somites and telson (× 80); prp. 2′ and prp. 4, distal segments of second and fourth peraeopods (× 160).

distal joints of the posterior peraeopods are considerably different, while the endopod of the uropod is longer in relation to the peduncle. The sculpture of the carapace in *tumida* is variable.

GYNODIASTYLIS INEPTA sp. nov.

Adult male. Integument semi-transparent.

Carapace one-third of total length of animal, somewhat inflated, wider than deep and breadth equal to length without pseudorostrum; antennal notch shallowly concave and antennal angle broadly rounded; on each side a low fold extends back from neighbourhood of antennal notch and below this is another longitudinal fold, the surface between being concave; the antero-lateral margin of the carapace flares outwards and is visible when the animal is viewed from

above. Pseudorostrum nearly one-fourth of length of carapace, pointed in front when seen from the side but each lobe narrowly and obliquely truncate anteriorly in dorsal view. Frontal lobe large and ocular lobe broad and short, two and one-half times as wide as long; the eyes are large, bright and shining.

Pedigerous somites together much less than half as long as carapace; the first somite is visible as a narrow strip, the lateral parts concealed beneath carapace and pleural portions of the short second somite; the third is short dorsally but has the pleural part expanded a little fore and aft on each side; fourth somite the longest in dorsal length, its pleural parts, like those of fifth, directed slightly backwards.

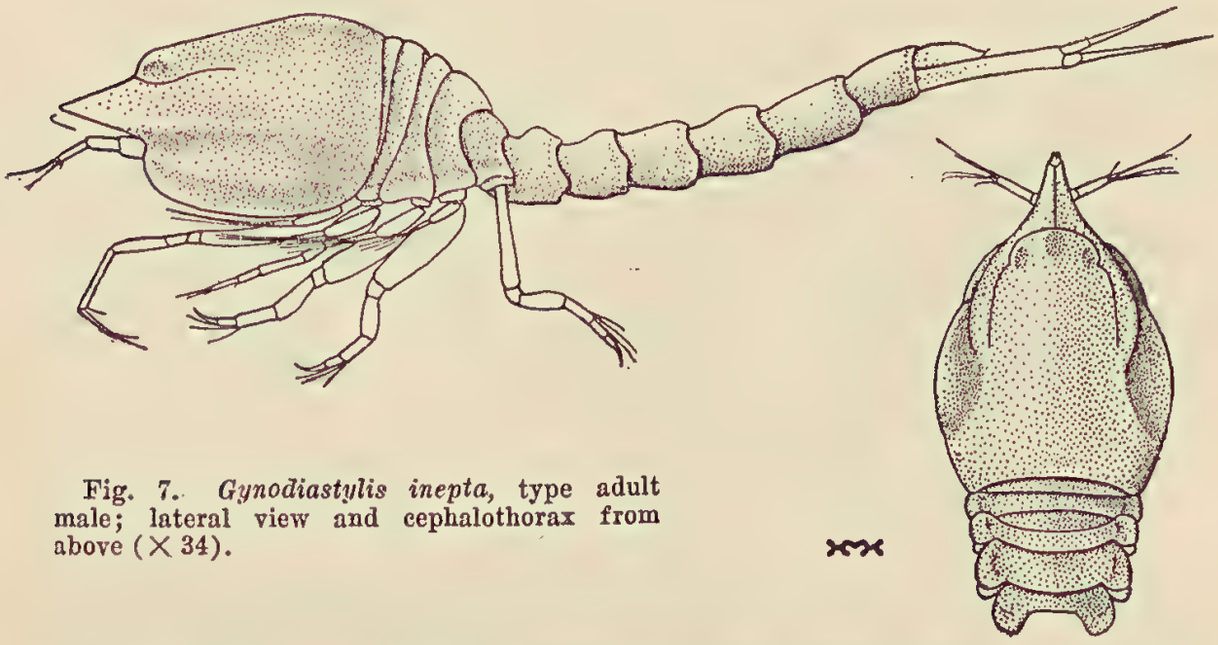


Fig. 7. *Gynodiastylis inepta*, type adult male; lateral view and cephalothorax from above (× 34).

Pleon a little longer than cephalothorax; fifth somite about one-fourth as long again as sixth, which is slightly dilated at the rear, where it is a little broader than length of the somite; telson not quite as long as sixth somite, almost twice as long as wide, and with a very short post-anal portion, narrowly subtruncate at distal end, which is furnished with a pair of short spines; the postero-lateral margins are finely serrate, with a bristle on each side near the terminal spines.

First antennae with second and third segments of peduncle subequal in length each a little longer than the stout first joint; the flagella do not differ much in length and each of them is three-jointed.

First peraeopod slender, the carpus not reaching to level of tip of pseudorostrum; basis shorter than remaining joints together; propodus a little longer than carpus and with a single distal seta; dactylus more than half as long as propodus; exopod rather small, with peduncle less than half as long as basis.

Second peraeopod with basis broad (three-fourths as wide as long) and not much longer than the three succeeding joints together; ischium distinct and carpus equal in length to propodus and dactylus together; the dactylus is three-fourths as long again as propodus and the exopod (not including flagellal setae) is fully as long as the basis.

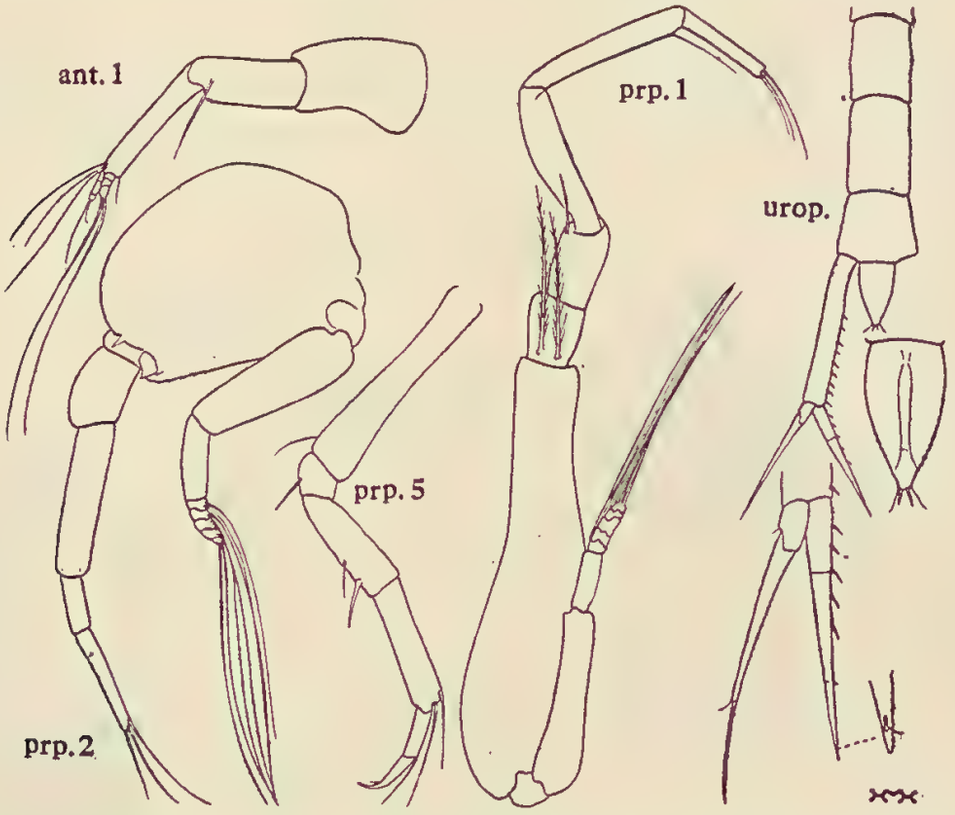


Fig. 8. *Gynodiastylis inepta*, paratype adult male; ant. 1, first antenna (× 95); prp. 1, 2 and 5, first, second and fifth peraeopods (× 95); urop., uropod with fourth to sixth pleon somites and telson (× 33; telson and rami of uropods, × 75).

Posterior peraeopods with carpus little longer than merus and with two carpal setae, the longer of which, like that of propodus, reaches to level of tip of dactylus; propodus and dactylus subequal in length, each much less than half as long as carpus; exopods on all but last pair, those of the fourth smaller than on the third; basis of fifth legs narrow, about as long as merus and carpus together.

Peduncle of uropod two and one-half times as long as telson, the distal two-thirds of inner margin armed with eight or nine short spines; endopod about four-fifths as long as peduncle, bisegmentate, the second joint almost half as long again as first; there are three spines on inner margin of first segment, one or two on second; the terminal spine is as long as the first segment, but is not distinctly marked off, and only with difficulty is its junction with the ramus discernible; the exopod (with terminal spine) is one-fifth as long

again as the total length of endopod; its terminal spine is one-half as long as the ramus but not distinctly differentiated from it.

Length 2·9 mm.

Loc. Western Australia: Garden Island, Careening Bay, 3 fathoms (A. G. Nicholls, submarine light, Nov., 1946). Type male in South Australian Museum, Reg. No. C. 3262.

Two males are available. These have the general facies of the large-eyed male described for *Gynodiastylis dilatata* (Hale, 1946, p. 375)—an otherwise easily separated species. Allowing for possible differences apparent in large-eyed males of *Gynodiastylis* and allied genera, *inepta* most nearly resembles the variable *G. tumida* (Hale, 1937, p. 66, fig. 3–4 and 1946, p. 419, fig. 45). It is distinguished from the male of *tumida*, however, by the following features. The sixth pleon somite is less dilated at the rear and the telson has a shorter and less narrowed post-anal part. The longer carpal seta of the posterior peraeopods (although stouter than its fellow) is not so thickened. In the uropod the peduncle is longer (less than twice as long as telson in *tumida* and with fewer spines on inner margin) and the spine of the endopod is not sharply marked off from the ramus. Further, not including the terminal spine in the length of either ramus, the exopod of the uropod of *inepta* is unusual in that it is longer than the endopod, whereas in *tumida* it is the shorter of the rami.

Genus DICOIDES Hale 1946.

Dicoides Hale, 1946, p. 421.

DICOIDES OCCIDENTALIS sp. nov.

Adult male. Integument slightly calcified; pedigerous somites, pleon, distal segments of limbs, and uropod with imbricate surface patterning.

Carapace one-third of total length and two-thirds as long again as pedigerous somites together; it is as deep as broad and half as long again as wide; on each side is a shallow depression; the inferior margin in anterior half bends outwards and is a prominent feature of the outline when the carapace is viewed from above; below the ocular lobe is a low tumidity on each side and the branchial regions are somewhat swollen. Frontal lobe very broad; ocular lobe rounded anteriorly, more than twice as wide as long, half as wide as carapace and with three large pale eyes. Pseudorostral lobes obliquely truncate anteriorly when seen from the side, meeting above for a distance equal to length of ocular lobe. Antero-lateral angle sinuate.

Pleon equal in length to cephalothorax; fifth somite one-third as long again as sixth, which is slightly wider than long; telson little shorter than sixth

somite, subtriangular and with two rather long terminal spines, each more than one-third as long as telson; no portion is post-anal.

First antenna geniculate; first segment of peduncle barely longer than third, and second much shorter; flagellum three-jointed, three-fourths as long as third peduncular segment; accessory lash two-jointed.

Second antenna reaching back little beyond hinder margin of carapace; its eleven-jointed flagellum is shorter than the peduncle.

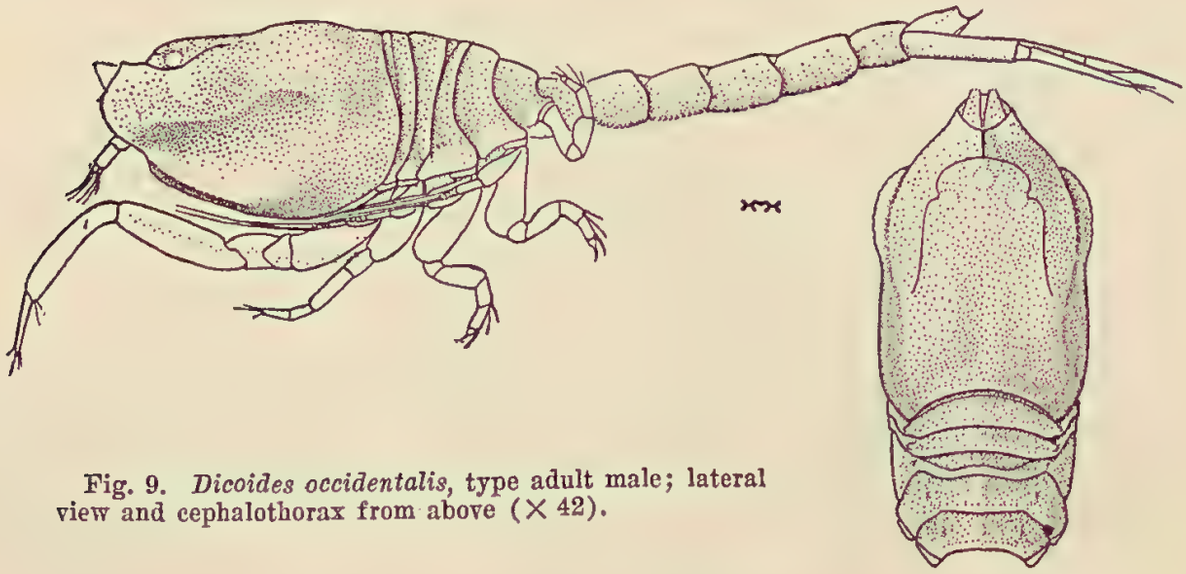


Fig. 9. *Dicoides occidentalis*, type adult male; lateral view and cephalothorax from above (× 42).

First to fourth pairs of peraeopods with well developed exopods. First pair with carpus reaching to level of anterior margin of carapace; basis short, two-fifths as long as rest of limb and equal in length to propodus, which is slightly shorter than the broad carpus; dactylus less than half as long as propodus, with a strong terminal claw (as in *D. fletti*) and some strong setae; there are no marginal setae on the carpus and propodus.

Second peraeopod with basis broad, much shorter than rest of limb; ischium indistinct and carpus as long as propodus and dactylus together.

Third and fourth peraeopods robust; basis broad, shorter than rest of limb; propodus longer than carpus and with a stout seta reaching to level of tip of the short and stout dactylus; two distal carpal setae, the longer not reaching beyond tip of dactylus.

Fifth peraeopod with basis much more slender than in fourth.

Uropod with peduncle two and one-half times as long as telson, and fully half as long again as fifth pleon somite; endopod six-sevenths as long as peduncle and equal in length to exopod; the first and last of its three indistinctly separated segments are subequal in length, each twice as long as second; inner margin with ten short spines and terminal spine stout, fully as long as

last segment of the ramus; exopod with three very unequal terminal spines (the longest nearly one-half as long as the ramus) and with a few short spines on outer margin.

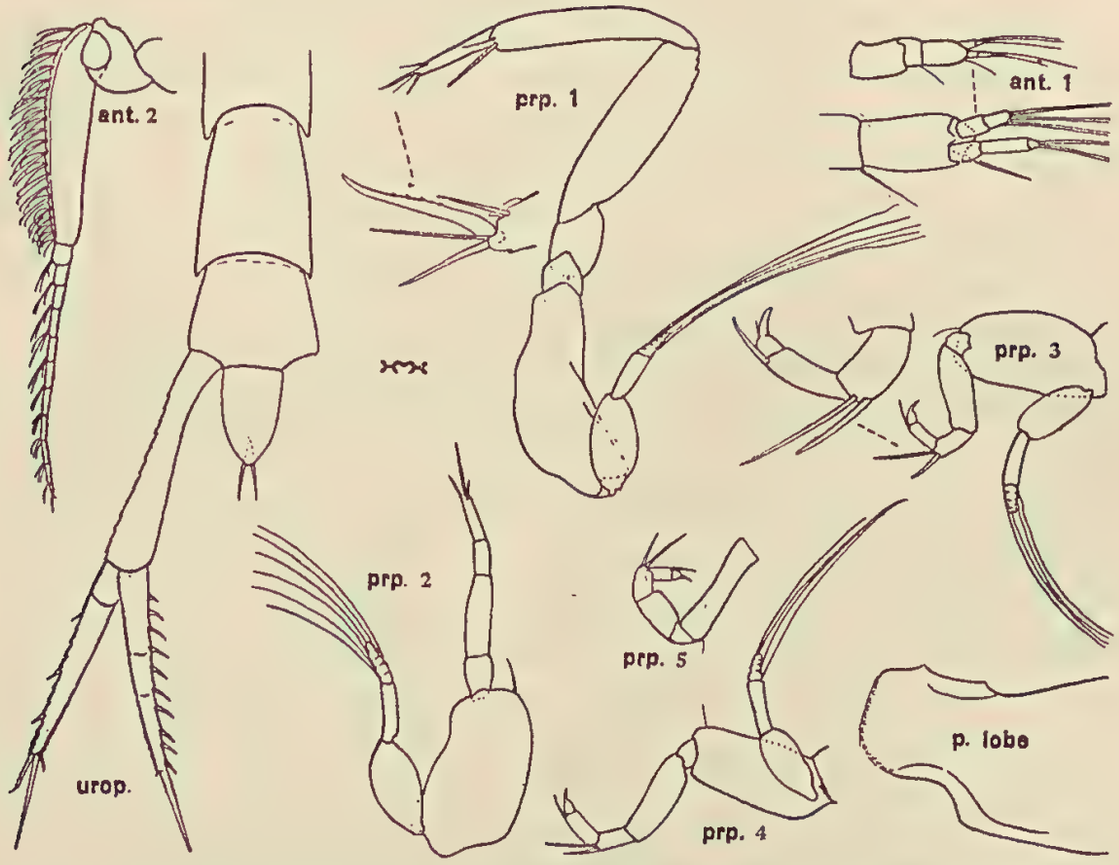


Fig. 10. *Dicoides occidentalis*, type adult male; p. lobe, inner view of right pseudorostral lobe; ant. 1–2, first and second antennae; prp. 1–5, first to fifth peraeopods; urop., uropod with fifth and sixth pleon somites and telson (× 64; flagella of first antenna, "claws" of first peraeopod and terminal joints of third peraeopod, × 180).

Colour cream. Length 2·2 mm.

Loc. Western Australia: Esperance Bay (A. G. Nicholls, submarine light, Jan., 1946). Type in South Australian Museum, Reg. No. C. 3223.

This species somewhat resembles *D. fletti* (Hale, 1946, p. 425, fig. 49–50) from the Pacific Coast of Australia. The size of the South-Western Australian form is considerably smaller and the shape and sculpture of the carapace are very different, although it must be remembered that the fully adult male of *fletti* is unknown. Further, however, the sixth pleon somite is relatively wider in *occidentalis*, the telson is longer, and the fossorial peraeopods are stouter and shorter, with the propodus relatively longer. Again, in the uropod the rami are of equal length and the second segment of the endopod is much shorter than the last; in the sub-adult male of *fletti* (4·6 mm.) the exopod of the uropod, as in the female, is distinctly shorter than the endopod, the segments of

which are distinctly marked off, the second being not markedly shorter than third, and the armature is as figured for the female (Hale *ut supra,* fig. 50, urop.).

The first peraeopods of *occidentalis* are relatively shorter than in the adult male of *areolata* or the sub-adult male of *fletti* and *brevidactyla*; these appendages agree, however, in having the propodus as long as the basis. The terminal telsonic spines are not rudimentary as in the adult male of *areolata,* but this cannot be regarded as of much significance (Hale, 1946, p. 361).

SUMMARY.

Diastylidae from Western Australia are dealt with. Sixteen species are listed for the State, including five which are described as new. These are *Paradiastylis whitleyi, Gynodiastylis munda, G. vicaria, G. inepta* and *Dicoides occidentalis.*

REFERENCES CITED.

Calman, W. T. (1904): "Report on the Cumacea collected by Prof. Herdman, at Ceylon, in 1902." *Ceylon Pearl Oyster Fish.* 1904, Supp. Rep. xii, pp. 159–180, pl. i–v.

Calman, W. T. (1905): "The Marine Fauna of the West Coast of Ireland, part iv. Cumacea." *Sci. Invest. Fish. Ireland,* 1904, app. 1, pp. 3–52, pl. i–v.

Calman, W. T. (1911): "On New or Rare Crustacea of the Order Cumacea from the Collection of the Copenhagen Museum. Part ii, The Families Nannastacidae and Diastylidae." *Trans. Zool. Soc.,* xviii, pp. 341–398, pl. xxxii–xxxvii.

Foxon, G. E. H. (1932): *Great Barrier Reef Exped.,* 1928–29, *Sci. Rep.,* iv, No. 11, pp. 387–395, fig. 5–10.

Hale, Herbert M. (1928): "Australian Cumacea." *Trans. Roy. Soc. S. Austr.,* lii, pp. 31–48, fig. 1–17.

Hale, Herbert M. (1936): "Three New Cumacea from South Australia." *Rec. S. Aust. Mus.,* v, pp. 395–403, fig. 1–6.

Hale, Herbert M. (1936a): "Cumacea from a South Australian Reef." *Rec. S. Aust. Mus.,* v, pp. 404–438, fig. 1–23.

Hale, Herbert M. (1945): "The Family Diastylidae, Part 1." *Trans. Roy. Soc. S. Austr.,* 69, (2), pp. 173–211, fig. 1–26.

Hale, Herbert M. (1946): "The Family Diastylidae, Part 2." *Rec. S. Aust. Mus.,* viii, pp. 357–444, fig. 1–60.

Zimmer, Carl (1914): *Fauna Südwest Aust.,* v, Cumacea, pp. 175–195, fig. 1–18.

PALAEOLITHIC *KODJ* AXE OF THE ABORIGINES
FURTHER NOTES

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

Text-fig. 1–4.

Since the publication of an account of the *kodj* axe of Western Australia at page 257 of this volume, additional information from various sources has come to hand.

I am indebted to Dr. R. Churchill Blackie, Curator of the Royal Albert Memorial Museum, Exeter, who kindly furnished the following note and drawing (text-fig. 1–4) to illustrate a very fine *kodj* hammer axe in his Museum:

"This specimen has an overall length of 30·8 cm., the visible length of the handle occupying 24·6 cm. The handle has an average width of 1·5 cm., is fire-hardened and pointed at the end, and is smooth and polished from much use.

"The head has an overall length of 10 cm. and a greatest thickness of 3·3 cm. The gum matrix is 5·5 cm. along the head, and 6·3 cm. in the line of the handle.

"As nearly as can be determined the hammer stone is 4·3 cm. long and the same width, and projects 2·5 cm. from the gum. The flake or axe-stone is 3·8 cm. long and 4·5 cm. wide, and projects 2 cm. from the gum. The axe-stone is set for use by a right-handed man. Both stones are of fine-grained basic igneous rock, probably basalt; and both appear to have been turned in the matrix at least once, as there is an old and blackened thin coating of gum on each. The axe-stone has become so blunt that it would have needed retouching to be of use.

"The gum is dark-brown, and is reinforced apparently with fibrous material which looks like stiff grass or cane splinters; and has at least a surface admixture of highly polished "desert" sand. The latter may, however, be merely accidental adhesion of sand while the gum was still unhardened. The total weight of the *kodj* is 283 grams. It is a very 'handy,' securely-made specimen, and from the condition of the stones and the patina of the handle has evidently seen much use in its original locality.

"It came to the Exeter Museum in 1882 and, considering the length of time it was in the donor's possession, and the types and workmanship of many of the Australasian objects which came in the same collection, the legitimate inference is that it must have reached England in about the 1840's. It has,

unfortunately, no exact locality, but is obviously a fine early specimen of the West Australian *kodj.*"

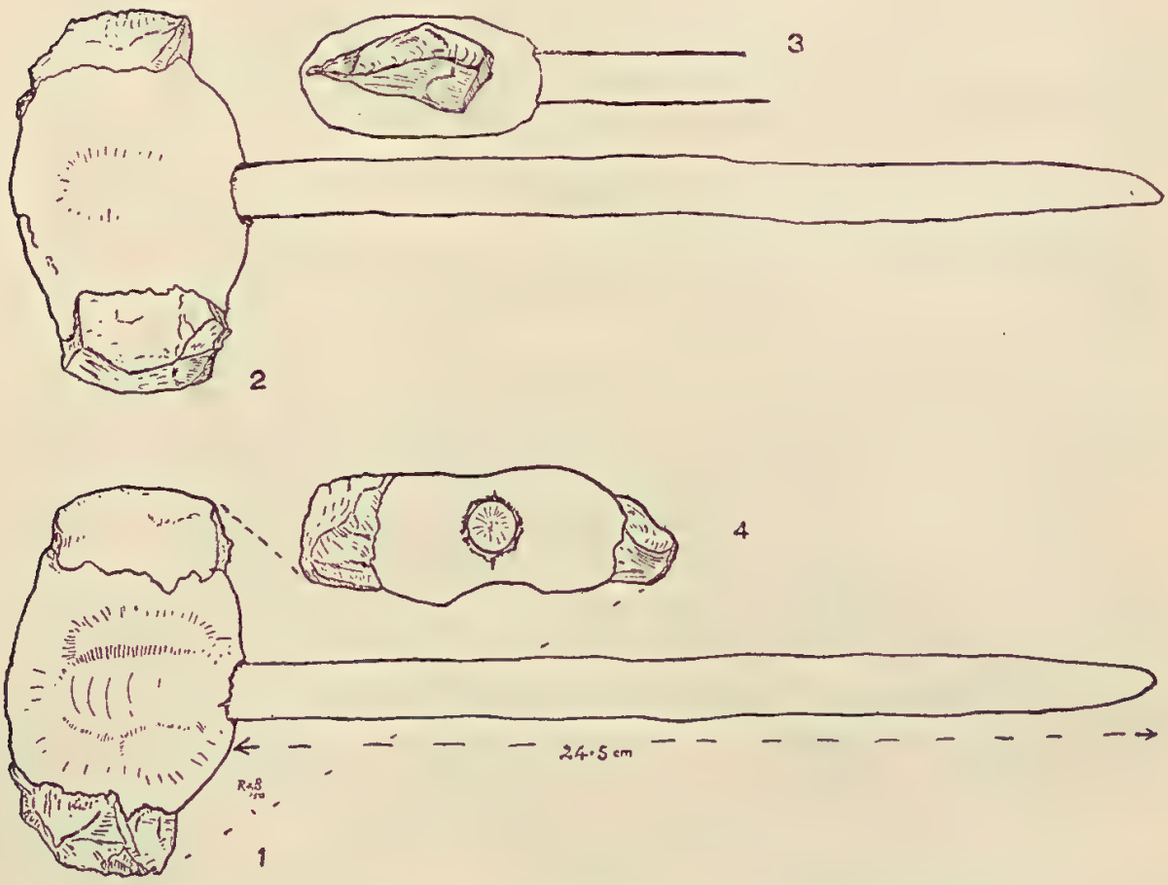


Fig. 1–4. *Kodj* axe in the Royal Albert Memorial Museum, Exeter.

Dr. Helmut Petri reported the regrettable loss of the specimen of a *kodj* axe (Tindale, 1950, fig. 5–7) by the destruction of the Städtisches Völker Museum, Frankfurt-am-Main. He writes: "Das in Ihrem Aufsatz abgebildete und beschriebene kodj ist leider nicht mehr vorhanden. Wir verloren es während der Bombenangriffe im Kriege. Soweit wir aber die Sache beurteilen können, ist Ihre Beschreibung und Abbildung des Objektes vollkommen korrekt, und wir freuen uns, dass dieses Stück, das nun leider verloren ist, wenigstens veröffentlicht wurde."

Davidson (1938) in a paper on stone axes of Western Australia, which was overlooked, described and illustrated two *kodj* axes which are now in the collection of the University of Pennsylvania Museum. One is from Quindalup in the Vasse district of Western Australia. It has a length of 40 cm. and a length of head 13·5 cm. From his illustrations it can be gathered that this axe was one made or used by a left-handed man. The other is somewhat smaller and seems cruder in manufacture; both have substantial handles and may be regarded as excellent examples of late *kodj* axes.

The *kodj* stones themselves are indicated by Davidson to be of poor type and, perhaps under the influence of the examination of these and some inferior examples in Australian museums, he came to the general conclusion that "these stones often are of such a crude nature that unless the possibility of recovering this type of ax is kept in mind the archaeologist might never suspect two stones lying near each other as the remains of a double-headed ax". In a map illustrating the distribution of Western Australian axe types he shows the *kodj* as extending from the vicinity of Geraldton to Geographe Bay. He uses vocabulary data on the *kodj* given by Curr (1886) to support conclusions based on the limited series of specimens he was able to examine.

Brough Smyth (1878) gave a good account of the *kodj* axe under the name *kodjo* or *koj-je*. He supplied useful data on methods of hafting with the gum of the blackboy (*Xanthorrhoea*). His informants, who, because of the words they used, may have been either Kaneang or Juat tribes-people, or both, distinguished between two grades of gum; they preferred that of a type of grass-tree called "tough top" to that of another called "brittle top." The Brough Smyth description and figure appear to be based on an example of relatively late manufacture with an ineffective handle. It is possible that his account is in some measure responsible for the incorrect impression current among those who have not handled early specimens, that a typical *kodj* axe stone would not be recognized as an implement if found as an archaeological specimen. He says: "If the stone forming the head of a West Australian tomahawk were found anywhere divested of the gum and handle, it is doubtful whether it would be recognized by any as a work of art."

That true *kodj* axe stones are a well-formed type was one of the theses of the earlier paper on this subject and this seems to be supported by the evidence furnished by the additional specimen brought to attention by Dr. R. C. Blackie, as well as by the fact that they were recognized as an archaeological type before they were associated with the *kodj* axe.

A notable archaeological find of a hafted implement by Setzler and McCarthy (1950) at Oenpelli in Arnhem Land was reported after the *kodj* paper had gone to press. The authors describe and figure a hafted stone implement from Oenpelli. It is fashioned from an *elouera* stone implement, set in gum on a wooden handle. At first sight their implement might be considered a form of axe and to be comparable with the *kodj*. However, McCarthy in a letter says, "Study of the use-polished edges in our series of implements from Oenpelli caves indicates that this edge was used chiefly on one face at a time, more than as a cutting implement. Thus it would appear to be an adzing rather than a cutting tool and for this reason we decided to call it an adze." Therefore, any resemblance of the Oenpelli implement to the true *kodj* axe would

seem to be accidental. The authors seem sure from their examination of the gum haft that this archaeological specimen has the stone still in its original position, i.e. no softening or slumping of the plastic mount has occurred, and the stone has not moved away from the working position. In view of McCarthy's opinion that the implement functioned as an adze it is not easy to see how an orthodox adzing operation was carried out with it and if its adzing function is correct, it might be inferred that deformation of the gum had occurred, after use. If deformation has occurred the implement originally may have resembled the normal Australian adze or chisel, in which the cutting edge of the stone is set squarely across the end of the handle.

Another possibility exists. Accepting that the *elouera* is in its proper position it could have been used for an activity such as the carving of spear barbs on a hardwood spear-head. Tindale (1925, fig. 41 A) from direct observation extending over many months at Groote Eylandt in 1921–22, described and figured this barb cutting activity, in which a stone knife is used. At Groote Eylandt the spear-head carver grasps the knife in the palm of his hand with the point directed towards his body, and the handle between the thumb and fingers; the back of the blade and the tip of the knife rest in the base of the palm. Steady cutting power is obtained by rotating the wrist outwards and levering the tip of the knife blade against the work. The levering action on the base of the palm combines great cutting power and marked control.

It seems possible that the Oenpelli implement could have been used in a like manner and if so used could have been an effective implement for the carving of the open hard wood barbs so widely used in North Australia.

SUMMARY.

This paper reports on hafted palaeolithic axes of the *kodj* type from Australia additional to those described in the Records of the South Australian Museum, ix, 1950, p. 257. The possible function of an archaeological *elouera* type adze recently found by Setzler and McCarthy at Oenpelli is discussed.

REFERENCES CITED.

Curr, E. M. (1886): Australian Race, Melbourne, 1.

Davidson, D. S. (1938): *American Anthropologist,* 40 (1), pp. 38–48, (bibliography).

Setzler, F. M. and McCarthy, F. D. (1950): A unique archaeological specimen from Australia. *Journ. Washington Academy of Science,* 40.

Smyth, R. Brough. (1878): Aborigines of Victoria, Melbourne.

Tindale, N. B. (1925): *Rec. S. Aust. Mus.,* ix (3), pp. 257–273.

ABORIGINAL ROCK CARVINGS: A LOCALITY NEAR PIMBA, S.A.

By F. J. HALL, R. G. McGOWAN and G. F. GULEKSEN.

Plates xxvi–xxvii and Text-fig. 1–35.

INTRODUCTION

During the month of June, 1950, the writers, seeking traces of aboriginal occupation in the vicinity of Pimba on the Adelaide to Perth Continental Railway line, found relics at several rock water holes in the bed of Eucolo Creek and in one of its tributaries. In the vicinity of the water holes evidence of previous native occupation was observed, including a series of rock carvings. A clue to the location of one of the sites was given by W. B. McDougall, Esq., whose assistance has been much appreciated.

THE LOCALITY.

Eucolo Creek is a channel some two miles long and approximately 200 feet wide for the greater part, forming a deep gully with cliffs often seventy feet high (Plate xxvi, A).

Massive sandstones and quartzites from the flat-topped tableland of this district (Segnit, 1939) and great slabs of this sandstone have been eroded to form the broken cliffs of the creek. Such erosion has formed many caves and the sides of the water course are littered with angular blocks of sandstone, often many tons in weight. Two small tributaries are minor duplicates of the main channel. This system debouches into alluvial flats which eventually terminate in the large saline depression of Island Lagoon.

THE ROCK CARVINGS.

Slabs of sandstone in some cases forming the bed of the water course and in other instances the cliff faces around the rock hole, are covered with a great profusion of carvings. The most extensive group of carvings occurs at the head of the creek where a rock hole provides only a temporary water supply, a more permanent water hole occurs a mile or more down the creek. Plates xxvi and xxvii show photographs of representative series of the carvings while the text figures give details of particular petroglyphs.

Plate xxvi, B shows a sandstone slab lying tilted at an angle of 45° in the creek bed and apparently so profusely engraved, over a long period, that few designs can be distinguished, details of the individual markings being lost in the whole. Before taking the photographs, details of some carvings were chalked in to enable them to be recorded with greater clarity. Plate xxvi, C shows human foot tracks, concentric circle designs and at the left what appear to be human figures bearing ornaments on their heads.

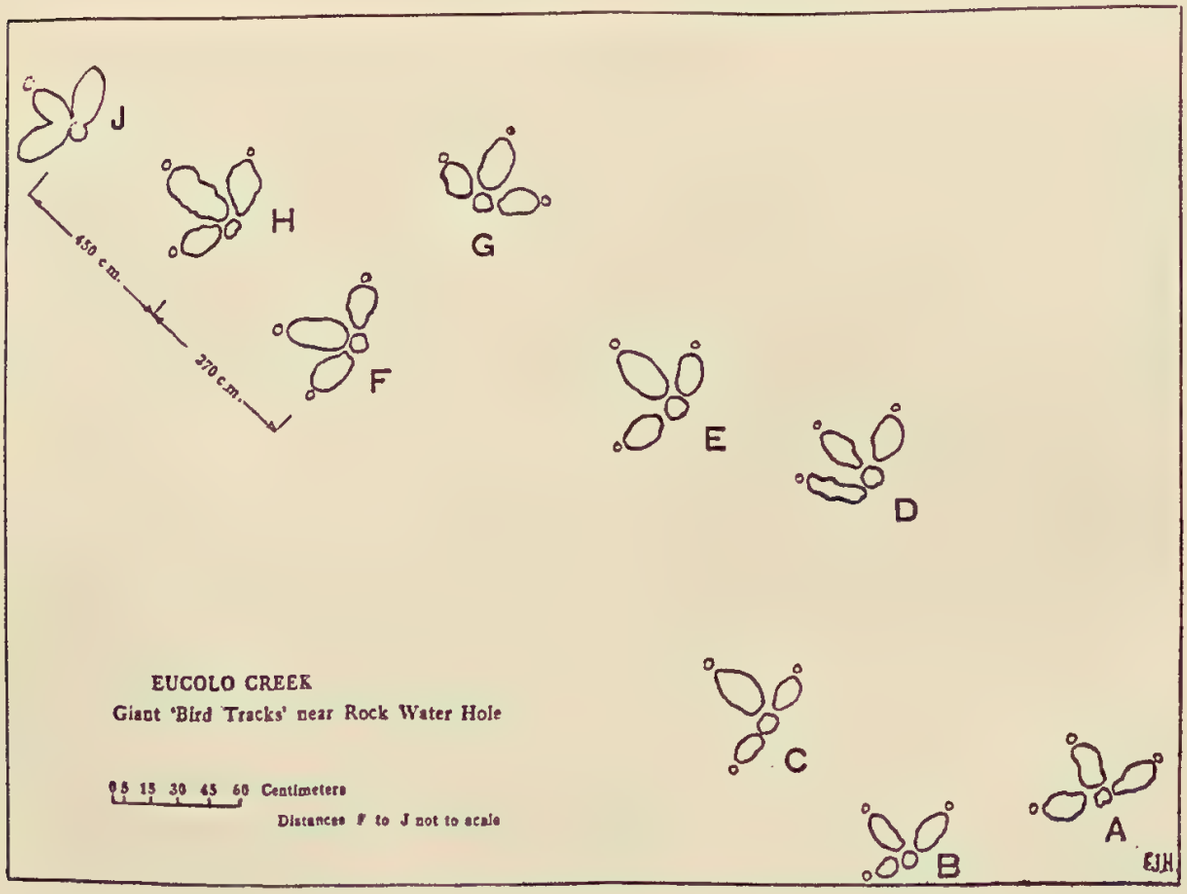


Fig. 1. Giant bird track carvings at Eucolo Creek.

Plate xxvi, D reveals a profusion of dog, kangaroo, emu and other tracks, while at E three male figures with ceremonial head dresses are shown; the outlines of two of the latter have been chalked in while a third can be distinguished in the bottom right-hand corner. The slab illustrated at F bears semi-circular designs similar to those sometimes used by present-day natives to represent the break-winds of their camps, and at other times used to represent boomerangs. A similar design with two such semi-circular carvings combined was present on a portable slab which is now in the South Australian Museum (No. A. 41967).

The rocks shown on Plate xxvi, G and H, bear large bird-track carvings and are extensively pitted and marked, and much eroded; the designs marked with chalk appear to be late ones in an indefinite series of older obscured carvings. These large emu-like bird tracks are the most interesting carvings in the series at Pimba. Typical ones are shown in Plate xxvi, G and H and others in Plate xxvii, C. A line of them which appears to represent a sequence of steps by a giant bird are drawn to scale in Text fig. 1. Individual steps are usually about a metre apart; in the series shown in the text figure there is a gap of 2·7 metres between steps F and H and 4·5 metres between footprints H and J. These footprints are carefully carved, the depressions being saucer-like with a depth of between 0·5 and 1·5 cm. A plaster cast of a typical example has been made and placed in the Museum collection (No. A. 41968).

Bird and animal tracks occur in a great abundance. A selection of the bird tracks is shown in text fig. 2–6, while fig. 7 represents kangaroo tracks. Sequences of dingo or dog tracks such as appear in text fig. 8 have been carved often; they are indicated well in Plate xxvi, D. Human hand and footprints are numerous (text fig. 9 and 10) and long and short meandering lines as shown in text fig. 11–12 occur. Several unusual groups of zoomorphic objects are found. Text fig. 13 is a lizard-like carving 133 cm. in length, forming the principal carving at the top of a block of sandstone on the side of the creek bed. The object is a true intaglio and would appear to be of some age, judging by the jointing of the rock; a typical fissure crossing it is 3 cm. in width and approximately 80 cm. deep, and has been split by temperature changes and weathered out since the carving was made. Another large intaglio, of no obvious meaning, and somewhat pear-shaped (text fig. 14) is carved on an isolated boulder in the bed of the creek. The snake-like design shown in text fig. 15 is among the larger figures present (176 cm.). Human figures have already been referred to; when present (fig. 16) they often appear to be wearing a ceremonial head dress; other possible human figures are less obvious, for example text fig. 17–19.

What appear to be symbolic designs comprise the greater majority of the carvings, but only a few of these are referred to here. A varied selection may be seen in Plate xxvi, in addition to the ever present animal tracks. The branched design at the right hand side of Plate xxvii, A, of the type called "fern leaf" by Mountford (1935), is characteristic, as are also the semi-lunate designs of Plate xxvi, B. Designs may be present in long and confused chains as in Plate xxvii, C. Concentric circles and designs featuring radiating lines, as in Plate xxvii, D, appear in numerous other series. Text fig. 20 represents

Fig. 2–35. Rock carvings at Eucolo Creek.

a characteristic type, a single line crossing a series of parallel lines at right angles.

Long meandering lines occur; sometimes these end in a series of radiating lines as in text fig. 21; this line may be broken at intervals with sets of radiating lines as in text fig. 22. Fig. 23 shows how two natural cavities in the rock (at *a* and *b*) are utilized to form an important part of a carving. Semicircular lines to which are attached many transverse bars on one side (text fig. 24) appear. In other instances the transverse bars are completely enclosed with a line as in Plate xxvi, F. The lastnamed is part of a series on a boulder in an isolated locality on the creek.

"U"-marks (text fig. 25) are present and there are two examples of a "U" within "U" design (text fig. 26). More complex designs of a similar nature are shown in text fig. 27–28. Circles and concentric series of circles, formed of dots (text fig. 29) and of solid lines occur. Approximately 20 concentric circles of various sizes were counted; text fig. 30–31 give typical examples of them.

Other designs present include a "barred circle" (text fig. 32) which occurs eight times. Many other designs, such as in text fig. 33–35, are represented by single examples.

SUMMARY.

This paper records a number of aboriginal petroglyphs at a site near Pimba, S.A., where a great variety and profusion of designs were observed. The occurrence of very large emu-like tracks suggest aboriginal knowledge of footprints of a creature now extinct. The jointing of the rock which now divides one figure into two, and the continuous repetition of design upon design until all become obscure suggests some degree of antiquity.

The authors appreciate the assistance of Messrs. H. M. Hale and N. B. Tindale in the preparation of this paper.

REFERENCES CITED.

Segnit, R. W. (1939): The Pre-Cambrian-Cambrian Succession, Adelaide.

Mountford, C. P. (1935): "A survey of the Petroglyphs of S. Australia." A. & N.Z. Ass. Adv. Science, Melbourne, 23, pp. 208–215.

EXPLANATION OF PLATES XXVI–XXVII.

Rock carvings at Eucolo Creek, Pimba, S. Australia.

A
B
C
D
E
F
G
H

B
D
A
C

COMMENTS ON SUPPOSED REPRESENTATIONS OF GIANT BIRD TRACKS AT PIMBA

By NORMAN B. TINDALE, B.Sc., Ethnologist, South Australian Museum.

The carved representations of tracks of a giant bird reported in the preceding paper by Messrs. Hall, McGowan and Guleksen from Pimba are of particular interest since they open up the distinct possibility that in Australia man may have been a contemporary of giant extinct birds such as *Genyornis newtoni,* and *Pachyornis queenslandiae* in the same way that the early Maori was the hunter and exterminator of the giant Moas of New Zealand. The story of the early New Zealand moa hunters has been carefully pieced together by Duff (1950) and others.

The detailed nature of the bird track marks from Pimba, showing as they do the separate claw and pad impressions of the bird, suggest that the artists were familiar with fresh tracks of the bird and were not merely depicting the footprints of an imaginary bird or the enlarged tracks of an ordinary emu.

The discovery does not stand alone. In Western Victoria a Tjapwurong tradition exists about a giant bird called ['mihiruŋ 'pariŋmal] much larger than the ordinary emu, which the Tjapwurong called ['pariŋmal]. Dawson (1881, p. 92) who was the first to notice the story gives the following account: "The aborigines have a tradition respecting the existence at one time of some very large birds, which were incapable of flight, and resembled emus. They lived long ago when the volcanic hills [of the Western districts of Victoria] were in a state of eruption. The native name for them is 'meeheeruung parrinmall'—'big emu,' and they are described, hyperbolically, as so large that their 'heads were as high as the hills,' and so formidable that a kick from one of them would kill a man. These birds were much feared on account of their extraordinary courage, strength and speed of foot. When one was seen two of the bravest men of the tribe were ordered to kill it. As they dared not attack it on foot, they provided themselves with a great many spears, and climbed up a tree; and when the bird came to look at them they speared it from above. The last specimen of this extinct bird was seen near the site of Hamilton."

Basedow (1907, p. 716) referred to the possibility of identifying some rock carvings at Balparana with *Genyornis* tracks but in a second paper (Basedow 1914, p. 200) he seems less definite about the value of his observations; the figure he gives (1914, pl. 1A) certainly is indeterminate and unlike

the clear cut ones from Pimba. Basedow (1914) states that "the traditions of the native embody references to emu-like and other monsters" but gives no particulars.

Other records of extinct animals supposed to be associated with the aborigines exist. Basedow (1914) refers to tracks identified as those of the great marsupial *Diprotodon* at Yunta. Hale and Tindale (1929, p. 30) recorded and figured a carving, made by aboriginals, of the head of an extinct crocodile-like animal at Panaramittee, and refer to legends of mythical animals, called Kaddikra, identified as crocodile-like and similar to descriptions of other mythical creatures of giant size called Kadimakara which were first noted in aboriginal legend by Gregory (1902). Mountford (1929) gave a detailed analysis of data on this discovery.

Taken as a whole the series of rock carvings reported by Messrs. Hall, McGowan and Guleksen agree with ones already reported from other places in South Australia and also with drawings made by present-day aborigines of the Great Western Desert of Australia. Further study of these will be necessary to determine successions of styles. There seems little reason to doubt, however, that the most recent of these carvings are related to contemporary aboriginal work. The giant bird tracks may be older, but on the evidence of the legend related by Dawson may not be very old since some of the volcanic craters of Western Victoria cannot have been extinct for very many centuries, and such realistic story details of a giant bird as are given by Dawson would not be likely to survive an indefinitely large number of generations of verbal transmission.

REFERENCES CITED.

Basedow, H. (1907) : Zeitschrift für Ethnologie, Berlin.

Basedow, H. (1914) : Journ. Roy. Anthrop. Inst. Gt. Britain, London 64.

Dawson, James (1881) : Australian Aborigines, Melbourne.

Duff, Roger (1950) : The Moa-Hunter Period of Maori Culture, Wellington (Bibliography).

Gregory, J. W. (1902) : The Dead Heart of Australia.

Hale, H. M. and Tindale, N. B. (1929) : South Australian Naturalist, Adelaide, 10 (2).

Mountford, C. P. (1929) : Trans. Roy. Soc. S. Australia. Adelaide, 53, pp. 245–248.

AUSTRALIAN RECENT AND TERTIARY MOLLUSCA

FAMILY CERITHIOPSIDAE

By BERNARD C. COTTON, Conchologist, South Australian Museum.

Plate xxviii.

INTRODUCTION.

The shells of the family Cerithiopsidae resemble those of the Cerithiidae in general features but they are small, narrow, cylindrical and tuberculate. They are distinguished from the true Cerithiidae in that the outer lip is not expanded, the nucleus of the operculum is sublateral, near the inner side of the aperture, there are no varices and the proboscis is retractile. The family may be regarded as intermediate between the Cerithiidae and the sinistral family Triphoridae. One new genus and six new species are introduced here, while some new records for Western Australia are added.

Specimens described are from the Verco Collection in the South Australian Museum. The following genera, subgenera or sections have been used, most of the typical species being originally or subsequently placed under the generic name *Cerithiopsis.*

Cerithiopsis Forbes and Hanley 1849. *Murex tubercularis* Montagu. Europe.
Cerithiospina Bartsch 1911. *C. necropolitana* Bartsch.
Disoniopsis Sacco 1895. *C. bilineata* Hörnes.
Cerithiopsida Bartsch 1911. *C. diegensis* Bartsch.
Cerithiopsidella Bartsch 1911. *C. cosmia* Bartsch.
Metaxia Monterosato 1884. *C. metaxae* Monterosato. Mediterranean.
Cerithiopsilla Thiele 1912. *C. cincta* Thiele. Antarctic.
Specula Finlay 1926. *C. styliformis* Suter. New Zealand.
Alipta Finlay 1926. *C. crenistria* Suter. New Zealand.
Mendax Finlay 1926. *C. trizonalis* Odhner. New Zealand.
Paramendax Powell 1937. *P. apicina* Powell.
Socienna Finlay 1926. *C. apicostata* May. New Zealand.
Zaclys Finlay 1926. *C. sarissa* Murdoch. New Zealand.
Joculator Hedley 1909. *C. ridicula* Watson. Wednesday Island, Cape York, N.E. Australia, 8 fathoms.
Cerithiella Verrill 1882. *Cerithium metula* Loven. Europe.

= *Lovenella* Sars 1878. *Cerithium metula* Loven. Non Hicks 1869.
= *Newtonia* Cossmann 1891. *Non* Schlegel 1866.
= *Newtoniella* Cossmann 1893. *Cerithium clavus* Lamarck.
= *Cerithiolinum* Locard 1903. *Cerithium metula* Loven.
Chasteria Iredale 1915. *C. danielsseni* Friele. England.
Onchodia Dall 1924. *C. benthica* Dall.
Stilus Jeffreys 1884. *C. insignis* Jeffreys. Atlantic.
Eumetula Thiele 1912. *E. dilecta* Thiele.
Laskeya Iredale 1918. *Turritella costulata* Möller. Northern Europe.
= *Eumeta* Mörch 1868. *Non* Walker 1855. *C. arctica* Mörch.
Seila Adams 1861. *S. trilineata* Philippi. West Indies.
= *Cinctella* Monterosato 1884. *C. trilineata* Philippi.
Viriola Jousseaume 1884. *Non* Tyron 1887.
Notoseila Finlay 1926. *Cerithium terebelloides* Martens. New Zealand.
Hebeseila Finlay 1926. *Seila bulbosa* Sowerby. New Zealand.
Proseila Thiele 1929. *Seila capitata* Thiele.
Seilarex Iredale 1924. *Seila attenuata* Hedley. Australia.
Euseila gen. nov. *E. pileata,* sp. nov., described in this paper.
Contumax Hedley 1899. *Contumax decollatus* Hedley. Funafuti.
Laeocochlis Dunker and Metzger 1874. *Laeocochlis granosa* Wood. Arctic Europe.
Callisteuma Tomlin 1929. *Callisteuma thelcterium* Tomlin. Japan.
Altispecula Powell 1930. *C. geniculosa* Hedley. South Australia.
Lyroseila Finlay 1928. *Seila chatamensis* Suter. New Zealand.
Seilopsis Tomlin 1931. *C. peilei* Smith. South Africa.
Sundaya Oliver 1915. *S. exquisita* Oliver. New Zealand.

AUSTRALIAN GENERA.

Australian species belong to eight genera.

Specula, Altispecula, Euseila, Socienna, Joculator, Notoseila, Zaclys, Seilarex.

KEY TO GENERA OF *CERITHIOPSIDAE.*

a. Protoconch of three whorls or less.
  b. Protoconch whorls smooth.
    c. Protoconch of one and a half rounded whorls .. *Specula*
    cc. Protoconch of two mamillate whorls.
      d. Adult sculpture of strong axial ribs .. *Altispecula*
      dd. Adult sculpture of fine spirals .. .. *Euseila*
  bb. Protoconch whorls axially sculptured .. .. *Socienna*

aa. Protoconch of four or more whorls.
e. Protoconch whorls smooth.
f. Protoconch many whorls, subulate .. *Joculator*
ff. Protoconch of four convex whorls .. *Notoseila*
ee. Protoconch whorls reticulate.
g. Adult whorls with spirals and weaker axials .. .. .. *Zaclys*
gg. Adult whorls with fine spirals .. *Seilarex*

SPECULA Finlay 1926.

Specula Finlay 1926, *Trans. N.Z. Inst.*, 57, p. 382.

Genotype. *Cerithiopsis styliformis* Suter 1908. New Zealand.

Protoconch of few whorls, typically one and a half, smooth and rounded whorls. Shell small, narrow, sculpture of beaded cinguli; whorls eight or nine, slightly convex; aperture subquadrangular produced below into a very short, open and emarginate canal.

Distribution. New Zealand and Australia.

Remarks. There are three Australian species, *S. mammilla* May, *S. turbonilloides* Tenison Woods and *S. regina* sp. nov.

KEY TO SPECIES OF *SPECULA.*

a. With golden coloured thread above suture .. .. *regina*
aa. Without golden thread.
b. Pyramidal .. .. *mammilla*
bb. Turreted .. .. *turbonilloides*

SPECULA REGINA sp. nov.

Plate 28, fig. 7.

Shell small, white turriculate, adult whorls eight, protoconch of two whorls, incomplete in all specimens, but paucispiral, rounded and smooth; sculpture on the body whorl of three spiral granule rows, granules developed at the intersection of axial and spiral lirae, twenty granules on the median spiral row of the body whorl; beneath the lower granule row is a fine smooth golden coloured spiral thread situated immediately above the sunken channelled suture so as to appear to be marking the suture with a golden band; the spiral thread conspicuous on the base where it runs to the top of the aperture; aperture subquadrate, produced into an open and short canal; outer lip sharp, but little convex; basal lip concave; colour shining-white except for the golden thread. Height 3·25 mm., diameter 1 mm.

Loc. Holotype: reg. No. D. 14,420, S.A. Museum. W.A., King George

Sound Beach. S.A., Gulf St. Vincent, dredged in shallow water. Cape Borda, 55 fathoms; Beachport, 150 fathoms.

This little species is readily distinguished from *S. turbonilloides* by the golden thread at the base of the whorls and by its shining surface and well defined granules.

SPECULA MAMMILLA (May).

Cerithiopsis mammilla May 1919, *Proc. Roy. Soc., Tas.*, p. 65, pl. 16, fig. 22.

Loc. The holotype came from Thouin Bay, 40 fathoms, East Coast of Tasmania. Two or three specimens from South Australia agree fairly well with the description of this species. They are pure white, not pale brown as in the Tasmanian species. There is a considerable variation in sculpture, some being almost destitute of nodules or there may be three strongly noduled keels on the adult whorls.

SPECULA TURBONILLOIDES (Tenison Woods).

Bittium turbonilloides Tenison Woods 1879, *Proc. Roy. Soc.*, Tas., p. 39.

The holotype came from Circular Head, Tasmania. It is reported from South Western Australia where the species appears to be fairly variable in sculpture.

Loc. S.A., Gulf St. Vincent, Robe, Port MacDonnell, Investigator Straits, 20 fathoms; Cape Borda, 55 fathoms; Cape Jaffa, 90 fathoms; Beachport, 150 fathoms and 40 fathoms; Venus Bay, St. Francis Island; W.A., King George Sound.

ALTISPECULA Powell 1930.

Altispecula Powell 1930, *Trans. N.Z. Inst.*, 60, p. 539.

Genotype. *Cerithiopsis geniculosus* Hedley 1911, forty miles south of Cape Wiles, 100 fathoms, South Australia.

Shell tall, narrow, gently tapering, strongly axially ribbed but with obsolete spiral sculpture; protoconch of two smooth convex whorls. Distinguished from the usual clathrate or strongly spirally ribbed *Cerithiopsis* by the sculpture, which is more like that of *Turbonilla*. In *Specula* Finlay 1926, the protoconch is few whorled, smooth and rounded but the sculpture of the succeeding whorls consists of strong spirals crossed by regular axials.

Distribution. Represented in New Zealand by *Altispecula elegantula* Powell 1930, from off Poor Knights Island in 60 fathoms. That species differs from the genotype in the presence of the central spiral thread, passing round the middle of the whorls.

ALTISPECULA GENICULOSA (Hedley).

Cerithiopsis geniculosus Hedley 1911. Forty miles south Cape Wiles, 100 fathoms, South Australia.

Shell rather large and solid, regularly tapering, much constricted between the whorls, glossy; colour uniform snow-white; whorls thirteen, including the protoconch; sculpture of strong radial ribs on all the whorls except the first two; ribs prominent medially, diminishing above towards the suture, suddenly truncate below at the basal angle, about fourteen to a whorl; intercostal spaces terminating squarely below, not continuous from whorl to whorl, a few faint spiral scratches appear in the interstices; base smooth; aperture pyriform, outer lip simple, canal short and broad. Length 9 mm., width 2 mm.

Loc. So far recorded only from the type locality.

EUSEILA gen. nov.

Genotype. *Euseila pileata* sp. nov.

Shell elongate, narrow, slowly tapering; columella twisted canal pointing sharply to the left; sculpture of three wide, flat, smooth spiral ribs; protoconch remarkably large, smooth mammilate, of two whorls, the last larger in diameter than the first adult whorl, the top a blunt spike.

Distribution. South Australia, dredged down to 300 fathoms. The aperture and canal recall that of *Mendax* Finlay 1926, but the protoconch is entirely different, resembling rather that of *Hebeseila* Finlay 1926. The adult shell is different in most respects from *Hebeseila.*

EUSEILA PILEATA sp. nov.

Plate 28, fig. 2, 3.

Shell elongate, narrow, slowly tapering to an acute apical angle; sides straight; adult whorls twelve; sculpture of three, flat wide spiral ribs, much wider than the interspaces which are very minutely longitudinally striated; decorated with obscure longitudinal reddish flames; aperture subquadrate, columella with fine spiral threads and canal deflected sharply to the left. Height 10 mm., diameter 2·25 mm.; a large specimen 13 mm.× 3 mm.

Loc. Holotype: reg. No. D. 14,421, S.A. Museum, S.A., Backstairs Passage, 20 fathoms. Also Beachport, 40, 49, 110, 150, 200, 300 fathoms; Cape Jaffa, 90, 130 fathoms; Cape Borda, 55, 62 fathoms; Newland Head, 20, 24 fathoms; St. Francis Island, 35 fathoms; Gulf St. Vincent, 14 fathoms; Grange Shell Sand, East of Neptunes, 45 fathoms; W.A., 80 miles west of Eucla, 80 fathoms.

The peculiar protoconch and sculpture are distinctive. There are a number of varietal forms.

(*a*) Narrower, two deeply engraved spiral lines nearer to the sutures than to each other.

(*b*) Whorls slightly convex, three engraved lines, reddish axial flames.

(*c*) Four spiral furrows, nearly equidistant, four spiral furrows on the rounded base, no spiral threads on the columella.

(*d*) Whorls seven, scarcely convex, an engraved line a little below the suture; whorl flat from suture to engraved line; a second engraved line around the base of the body whorl from the suture.

(*e*) Specimens from Beachport, 200 fathoms, have the infrasutural band yellowish; some show axial flames; some are nearly straight sided; some with widely impressed suture; some with slightly convex whorls.

There is a possibility that more than one species is represented in this assemblage. The protoconch is somewhat like that of *Hebeseila bulbosa* Suter but the shell is differently shaped.

SOCIENNA Finlay 1926.

Socienna Finlay 1926, *Trans. N.Z. Inst.*, 57, p. 382.

Genotype. *Cerithiopsis apicostata* May 1919. Tasmania.

Shell small, elongate, narrowly pyramidal; whorls eleven, including the protoconch; protoconch of three whorls, strongly axially ribbed, paucispiral, flattened on top, rather swollen.

Distribution. Australia.

KEY TO SPECIES OF *SOCIENNA*.

a. Height over three times diameter, sculpture moderately developed .. .. *apicostata*

aa. Height under three times the diameter, sculpture strongly developed .. .. *trisculpta*

SOCIENNA APICOSTATA (May).

Cerithiopsis apicostata May, 1919, *Proc. Roy. Soc., Tas.*, p. 64, pl. 16, fig. 21-21a.

There is some variation in South Australian specimens.

Loc. Tas., Cape Pillar, 100 fathoms (type), 40 fathoms, S.A., Cape Borda, 55 fathoms; Cape Jaffa, 90–130 fathoms; Beachport, 40–150 fathoms; Backstairs Passage, 22 fathoms; thirty-five miles S.W. of Neptune Islands, 104 fathoms. W.A., eighty miles west of Eucla, 80 fathoms.

SOCIENNA TRISCULPTA (May).

Cerithiopsis trisculpta May, 1912, *Proc. Roy. Soc.*, Tas., p. 46, pl. 2, fig. 4.

South Australian specimens are usually atypical, some being more slender and more finely sculptured than Tasmanian specimens. A few like those from Beachport, 40 fathoms, are typical.

Loc. Tas., Derwent Estuary (type), S.A., Beachport, 40 fathoms; Cape Jaffa, 90 and 30 fathoms; Cape Borda, 55 fathoms.

JOCULATOR Hedley 1909.

Joculator Hedley 1909, *Proc. Linn. Soc., N.S.W.*, 34, pl. 3, p. 442.

Genotype. *Cerithiopsis ridicula* Watson 1886—Wednesday Island, Cape York, 8 fathoms.

Shell small, dextral, ovate or bulbous contour, with a smooth subulate, many-whorled protoconch.

Distribution. Australia. Flindersian and Peronian, Fiji, New Zealand.

Australian species of the genus are: *J. cessicus* Hedley 1906; *J. ridicula* Watson 1886, four species from Hope Island, Queensland, namely *J. tribulationis* Hedley 1909, *J. westianum* Hedley 1909, *J. telegraphica* Hedley 1909, *J. pinea* Hedley 1909. Also two new species *J. introspecta* and *J. flindersi* described here.

JOCULATOR CESSICUS (Hedley).

Cerithiopsis cessicus Hedley 1906, *Proc. Linn. Soc., N.S.W.*, 30, p. 529.

This name was introduced to replace *Bittium minimum* Tenison Woods 1878 from Blackman's Bay, Tasmania, that name being previously used by Brusina 1864 for a Mediterranean species. This shell is something like a very minute *Cacozeliana granarium* Kiener; the upper whorls appear to be margined with a very dark brown line.

Loc. S.A., Grange, shell sand; Investigator Straits, 20 fathoms; 35 miles south-west of Neptune Island, 104 fathoms; Beachport, 150 fathoms; north of Cape Borda, 55 fathoms; W.A., King George Sound, beach; eighty miles west of Eucla, 80 fathoms.

JOCULATOR INTROSPECTA sp. nov.

Plate 28, fig. 5.

Shell small, pupoid, colour ochraceous, protoconch white, of five and a half smooth subulate whorls; adult sculpture of three rows of strong tubercles on each of the three later whorls; axial plicae correspond with the vertical rows of

the granules but are not very well developed; suture deeply furrowed, base spirally lirate. Height 2·5 mm., diameter 0·75 mm.

This species resembles *Joculator ridicula* Watson, from Cape York, the genotype, but may be distinguished by the less convex whorls, less developed axial plicae and the finer sculpture; it is also somewhat like *Joculator tribulationis* Hedley, Hope Island, Queensland; it may also be mistaken for a micromorph of *Joculator cessicus* Hedley.

Loc. Holotype: reg. No. D. 14,422, S.A. Museum. S.A., North-West of Cape Borda, 55 fathoms, also one specimen in 60 fathoms.

JOCULATOR FLINDERSI sp. nov.

Plate 28, fig. 6.

Shell small, pupoid, colour ochraceous, whorls five and a half; sculpture of two rows of large granules on each whorl, each row of granules being about the same size, the lower very slightly smaller; immediately beneath the lower row on the body-whorl is a strong spiral of small nodules; smooth ribs succeeded by less pronounced ones on the base; between the two rows of granules is a narrow, deep furrow; aperture subquadrate, canal short; protoconch broken in our type specimen, but smooth subulate white, many-whorled. Height 2·1 mm., diameter 0·75 mm.

Loc. Holotype: reg. No. D. 14,423, S.A. Museum. S.A., north-west of Cape Borda, 55 fathoms.

This species is somewhat like *Joculator westianum* Hedley, from Hope Island, Queensland. It can be readily distinguished by the relative size of the two granule rows which are almost equal, whereas in *J. westianum* the lower row, as seen particularly on the body whorl, is decidedly smaller. *Joculator balteata* Watson from Fiji is even less like the present species in the comparatively greater difference in size between the two granule rows.

NOTOSEILA Finlay 1926.

Notoseila Finlay 1926, *Trans. N.Z. Inst.*, 57, p. 382.

Genotype. *Cerithiopsis terebelloides* Hutton 1873, New Zealand.

Shell small, subcylindrical, thin and fragile; sculpture of three spiral keels of equal strength on the upper whorls, four keels on the body whorl with a fifth below the periphery of the base; protoconch long cylindrical, of four convex and smooth whorls, the nucleus mammilate.

Distribution. Australia and New Zealand, Recent and Tertiary.

KEY TO SPECIES OF *NOTOSEILA*.

a. Colour orange throughout, height less than four times the diameter .. .. *crocea*
aa. Colour marbled, yellow or white banded, height four times or more than four times the diameter.
b. Colour purplish brown sutures white banded, height more than four times the diameter .. .. .. *albosutura*
bb. Colour marbled or yellow, suture not white banded, height four times the diameter.
c. Colour marbled .. .. *marmorata*
cc. Colour pale yellow .. .. *halligani*

NOTOSEILA CROCEA (Angas).

Cerithiopsis crocea Angas 1871, *Proc. Zool. Soc., Lond.*, p. 61, pl. 1, fig. 13.

Cerithiopsis atkinsoni Tenison Woods 1876, *Proc. Roy. Soc., Tas.*, p. 139.

Generally distributed through the Peronian and Flindersian Regions. Specimens from Aldinga range up to 25 mm. in length.

Loc. N.S.W., (type) Tas. (type *C. atkinsoni*) Vict., general S.A., Kangaroo Island, Outer Harbour, Middleton, Edithburgh, Aldinga, Corny Point, St. Francis Island; dredged Beachport, 110 fathoms; Normanville, 19–20 fathoms; Backstairs Passage, 17 and 22 fathoms; W.A., Albany, Ellenbrook, Yallingup.

NOTOSEILA ALBOSUTURA (Tenison Woods).

Cerithiopsis albosutura Tenison Woods 1876, *Proc. Roy. Soc., Tas.*, p. 140.

Cerithiopsis purpurea Angas 1877, *Proc. Zool. Soc., Lond.*, p. 36, pl. 5, fig. 7.

Differs from *N. crocea* in being smaller, more cylindrical, having a narrower base and white suture.

Loc. Victoria, Bass Straits (type), N.S.W. (type of *N. purpurea*), S.A., Venus Bay, MacDonnell Bay, Gulf St. Vincent and Spencer Gulf beach and dredged in 14 fathoms, numerous, also Cape Borda, 55 fathoms.

NOTOSEILA MARMORATA (Tate).

Cerithiopsis marmorata Tate 1893, *Trans. Roy. Soc., S. Aust.*, p. 190.

Shell elongately acuminated, marbled with white and brown, encircled by rounded cinguli and axially striated in the intervals; posterior whorls with four cinguli; five on the penultimate; five on the body-whorl posterior to the

periphery, with or without a slender one interposed between the first and second from the suture; the base with one cingulus in front of the periphery. Height 16 mm., diameter 4 mm.

Loc. Holotype: reg. No. D. 13,438, S.A. Museum. S.A., Port MacDonnell, both gulfs, dredged in shallow water down to 22 fathoms. This species is more slender than *Notoseila crocea* and stouter than *Notoseila albosutura.* In sculpture it approximates to *Notoseila crocea* but appears to have more cinguli on the body whorl. The colour is distinctive.

NOTOSEILA HALLIGANI (Hedley).

Cerithiopsis halligani Hedley 1905, *Rec. Aust. Mus.*, 6, p. 51, fig. 16.

The holotype comes from Cape Byron, N.S.W., 111 fathoms.

A few South Australian dredged specimens approach this species in general appearance and protoconch features.

Loc. S.A., Cape Borda, 55 fathoms; Beachport, 40 fathoms.

ZACLYS Finlay 1926.

Zaclys Finlay 1926, *Trans. N.Z. Inst.*, 57, p. 382.

Genotype. *Cerithiopsis sarissa* Murdoch 1905. Whangaroa Harbour, New Zealand.

Shell small, narrow tapering to a slender point with spiral and slightly weaker axial riblets; protoconch many-whorled, reticulate ending in a carina and not smooth as implied in the original description of the genotype species. Australian species are *Z. dannevigi* Hedley 1911, *Z angasi* Semper 1874, = *clathrata* Angas 1871, *Z. semilaevis* Tenison Woods 1877, *Z. styliferus* sp. nov. *Z. cacuminatus* Hedley and Petterd 1906.

Distribution. Australia and New Zealand.

ZACLYS STYLIFERUS sp. nov.

Plate 28, fig. 1.

Shell elongately acuminated, dark brown in life, whorls about twelve including the protoconch; protoconch of four whorls, the third roundly angulated and the fourth more distinctly carinate and granulated at the angle; first spire whorl with two spiral costae, the posterior less valid, second whorl with two equal and a smaller one posteriorly; in each successive whorl the posterior costa becomes more valid; axial lirae numerous and close-set rather less than half as thick as the spiral costae, which they cross, dipping down into the interstices, the points of intersection having distinct round tubercles; sutures dis-

tinct; interval between spirals at suture wider than the interval between the middle and posterior costae, equal to that between the middle and anterior from which it is distinguished by its greater depth; body whorl with narrow peripheral costa in which the actual lirae end, granulating its posterior margin; base concave, barely microscopically axially striate; aperture squarely rotund, outer lip rather corrugate curving posteriorly, canal short, bent slightly to the left and open; inner lip thin, columella nearly straight. Height 5 mm., diameter 1 mm.

This species is related to the Peronian *Zaclys angasi* Semper 1874, Port Jackson, New South Wales = *C. clathrata* Adams 1871 Sow and Pigs, Port Jackson, but differs in being smaller, comparatively narrower, whorls slightly more convex. Some specimens are very narrow.

Loc. Holotype: reg. No. D. 14,424, S.A. Museum. S.A., Cape Borda, 55 fathoms; also shell sand, Gulf St. Vincent, Port MacDonnell to Sceales Bay and down to 150 fathoms; W.A., King George Sound, Ellenbrook, Hopetoun, Vict.

ZACLYS DANNEVIGI (Hedley).

Cerithiopsis dannevigi Hedley 1911, *Zool. Res.* "Endeavour," pt. 1, p. 109, pl. 19, fig. 26, 27.

Loc. S.A., Cape Wiles, 100 fathoms (type); Cape Borda, 55 fathoms; 62 fathoms; Beachport, 40 fathoms; Cape Jaffa, 90 fathoms; Neptune Island, 104 fathoms; W.A., eighty miles west of Eucla, 80 fathoms.

ZACLYS CACUMINATUS (Hedley and Petterd).

Cerithiopsis cacuminatus Hedley and Petterd 1906, *Rec. Aust. Mus.*, 6, p. 218, pl. 37, fig. 4.

The few S.A. and W.A. specimens are atypical and doubtful identifications.

Loc. N.S.W., Sydney, 300 fathoms (type); S.A., Beachport, 150 fathoms; W.A., King George Sound, Yallingup, Rottnest.

ZACLYS SEMILAEVIS (Tenison Woods).

Bittium semilaevis Tenison Woods 1877, *Proc. Roy. Soc., Vict.*, p. 58.

South Australian specimens are a little more coarsely sculptured though probably the same species.

Loc. N.S.W., Tas. (type), Vict., Western Port; S.A., Cape Borda, 55 fathoms; Beachport, 40 fathoms; Cape Jaffa, 90 fathoms; W.A., King George Sound.

SEILAREX Iredale 1924.

Genotype. *Seila attenuata* Hedley 1900. Middle Harbour, Sydney, New South Wales.

Shell dextral, very tall and slender, gently tapering, varies a little in proportion; whorls thirteen, gradually increasing rounded, contracted at the sutures; protoconch whorls obliquely longitudinally ribbed, a keel appears, the ribbing diminishes, and by gradual transition the adult sculpture is attained.

Distribution. Eastern and Southern Australia and Tasmania. *Seilarex turritelliformis* Angas 1877 is also included in this genus.

KEY TO SPECIES OF *SEILAREX*.

a. Intercalating spiral sculpture .. .. *attenuata*
aa. Non-intercalating spiral sculpture .. .. *verconis*

SEILAREX ATTENUATA (Hedley).

Seila attenuata Hedley 1900. *Proc. Linn. Soc., N.S.W.*, 25, p. 91, pl. 3, fig. 9.

Some specimens from Tasmania are coarser than the New South Wales examples from the type locality, Middle Harbour, a characteristic which is easily recognized in May's figure. Illustrated Index of Tasmanian Shells, pl. 27, No. 12. Specimens off Schouten Island, 40 fathoms, however, approximate to New South Wales species and are quite different from the South Australian shells.

SEILAREX VERCONIS sp. nov.

Plate 28, fig. 4.

Shell tall, slender, thin, translucent unicoloured throughout, cream to pale yellow; whorls fourteen, gradually increasing very convex, constricted at the sutures; sculpture of eight equal, fine spiral sharp cords, constant throughout, interspaces crossed by arcuate growth striae; base flattened faintly spirally ribbed; columella arched, canal short, deflected to the left; protoconch as in genotype description, same colour as the rest of the shell. Height 15 mm., diameter 3 mm. This species is distinguished from the genotype *S. attenuata* by its great size, more delicate translucent shell, fine regular not intercalating sculpture and uniform and cream colour. It has been taken dredged alive but not found on the beaches in South Australia.

Loc. Holotype: reg. No. D. 14,425, S.A. Museum, S.A., Cape Borda, 55 fathoms; Backstairs Passage, 20 fathoms; Newland Head, 20 fathoms; south-west of Neptune Island, 104 fathoms; St. Francis, 35 fathoms.

TERTIARY SPECIES.

The following Tertiary species are tentatively placed in revised genera as follows:

Specula Finlay 1926.

praelongatus Ludbrook 1941. Adelaidean, Pliocene.

Manulona Ludbrook 1941.

lirasuturalis Ludbrook 1941. Adelaidean.

Notoseila Finlay 1926.

crocea Angas 1871. A species resembling this recent one occurs in the Adelaidean.

Cerithiella Verrill 1882.

salteriana Tenison Woods 1879. Miocene.

cribaroides Tenison Woods 1879. Balcombian and Janjukian.

reticosa Chapman and Crespin 1928. Miocene.

trigemmata Chapman and Crespin 1928. Miocene.

Zaclys Finlay 1926.

mitchellensis Chapman and Crespin 1928. Mitchell River, Miocene.

Seilarex Iredale 1924.

turritelliformis Angas 1877. Recent (Type). Balcombian?

Joculator Hedley 1909.

mulderi Tate 1897. Fyansford, Miocene.

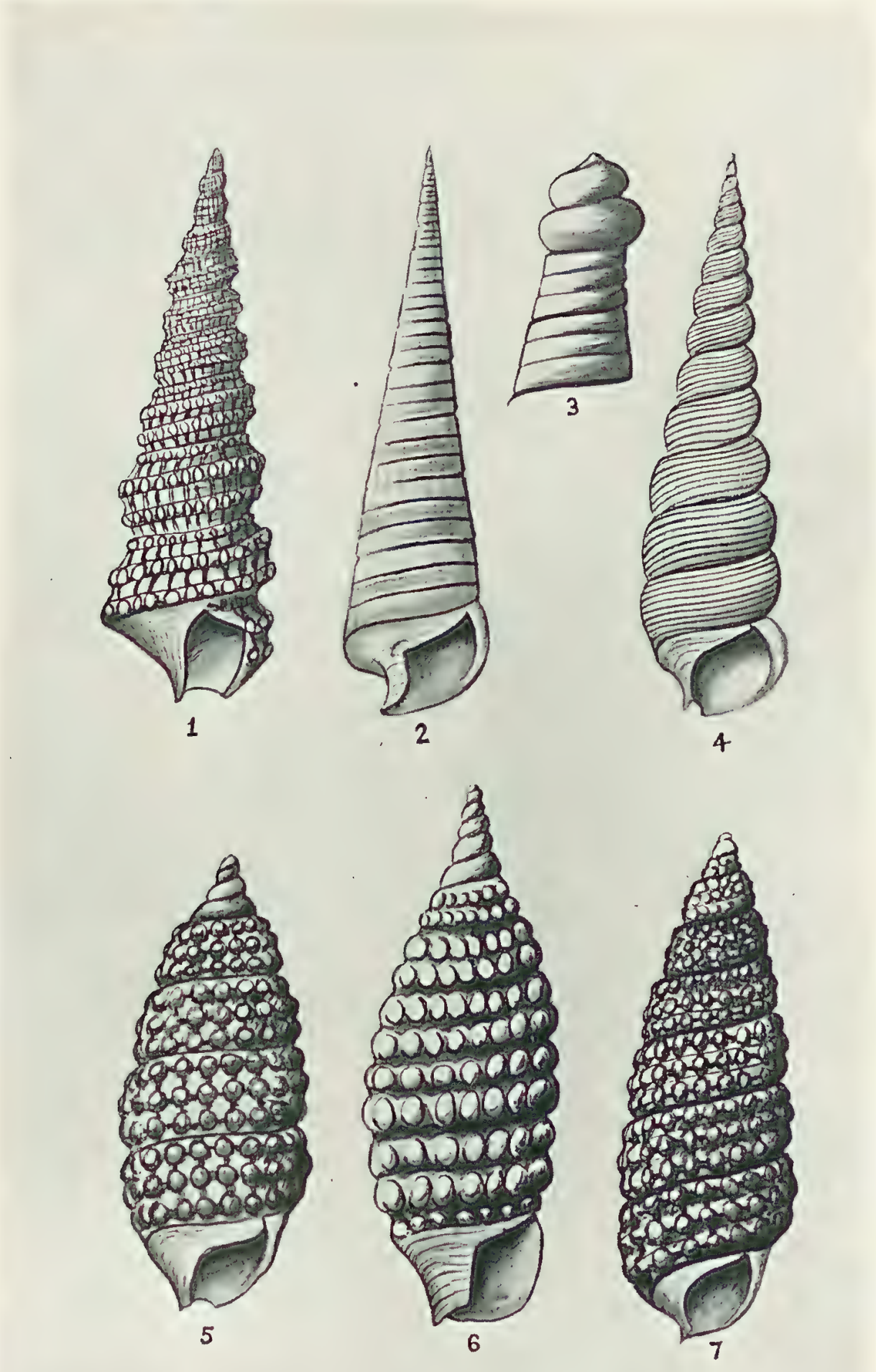
Zaclys Finlay 1926.

woolnoughi Chapman and Crespin 1933. East Gippsland, Kalimnan, Pliocene.

EXPLANATION OF PLATE.

Plate xxviii.

Fig. 1. *Zaclys styliferus* sp. nov. Holotype. × 16.
Fig. 2. *Euseila pileata* sp. nov. Holotype. × 8.
Fig. 3. *Euseila pileata* sp. nov., protoconch. × 40.
Fig. 4. *Seilarex verconis* sp. nov. Holotype. × 5·5.
Fig. 5. *Joculator introspecta* sp. nov. Holotype. × 27.
Fig. 6. *Joculator flindersi* sp. nov. Holotype. × 36.
Fig. 7. *Specula regina* sp. nov. Holotype. × 23.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A REVISION OF THE AUSTRALIAN GRYLLOIDEA

By LUCIEN CHOPARD, Paris.

Text. figs. 1–89.

The Grylloidea of Australia are known from a certain number of species formerly described by Francis Walker and Henri de Saussure, and more recently by the list which I gave in 1925, following the study of the collections brought back by Dr. Mjöberg's Swedish scientific expeditions (Ark. f. Zool., 18A, No. 6). Since that time, I have received much important material from the South Australian Museum, Adelaide, the Australian Museum, Sydney, and the Queensland Museum, Brisbane. I wish to express my deep appreciation to the Directors and Entomologists of these Museums for their generous assistance.

Unfortunately the study of this material has been long delayed owing to the difficult conditions in Europe during the years 1940–45. It is only now that I am able to bring forward the result of the examination of these important collections of Australian Grylloidea. The number of known species in this group is now 138, that is about 40 more than in my report of 1925; most of the species new to Australia are also new to science and are described in this paper. In spite of the relative importance of these collections, it must be emphasized that the Australian fauna is still far from being completely known. Very likely a number of Papuan species will be found in Queensland and the Northern Territory and an equally important number of new species probably remain to be discovered, mainly in the less known parts of Australia.

It seems, however, possible to draw preliminary conclusions from the characteristics of the known species. Although the fauna is not a very rich one as compared with that of Indo-Malaisia, almost all the families are represented and no striking negative feature can be noted. It is not surprising to note that the Australian fauna contains a large number of endemic species and genera. More than ten genera are at present known from Australia only, the more remarkable of which are *Scapanonyx, Cyrtoprosopus, Mjöbergella, Dictyonemobius, Eurygryllodes, Endotaria, Hemiphonus, Hemiphonoides.*

In the family Gryllidae and the subfamily Gryllinae, the genus *Grylludus* is best represented with 17 species, mostly of small size and forming a rather special group related to *G. blennus* Sauss., from Java. The genera *Loxoblemmus* and *Gryllopsis,* so abundantly represented in the Indo-Malaisian fauna, are represented by one species only. *Landreva* does not occur in Australia but is replaced by the endemic genera *Copholandrevus* and *Mjöbergella,* the latter

being strongly specialized for digging. In the same subfamily, the group Brachytrypites is well represented by the genera *Apterogryllus, Scapanonyx* and *Cephalogryllus*; in their powerful legs, armed with strong, flattened tibial apical spurs, these are particularly adapted for digging. *Brachytrypes portentosus,* so common in all the Oriental region, has not reached Australia and there is no true *Gymnogryllus* in the Australian fauna. The Nemobiinae are not very numerous but are represented by the rather characteristic genus *Dictyonemobius.*

In the family Pentacentridae, the genus *Pentacentrus,* which is one of the characteristic elements of the Indo-Malaisian and Papuan faunas, is represented in Australia by one species only; but the very special endemic genus, *Eurygryllodes,* is most probably a member of this family.

The Phalangopsidae are mainly represented by the genus *Endacusta* with about 10 species and the neighbouring genus *Endotaria* which is an apterous form probably derived from the former.

Among the Oecanthidae, we note the presence of a *Xabea,* a genus very characteristic of the Indo-Malaisian fauna.

The small Grylloids of the family Trigonidiidae are represented by a certain number of species, chiefly of the genus *Metioche;* their affinities are evidently with the Papuan and Indo-Malaisian faunas; the only interesting type is the endemic *Dolichoxipha gracilipes.*

The genus *Eurepa* of the Eneopteridae is restricted to the Australian fauna; this family is also represented by *Cardiodactylus,* so common in all the islands of the Oriental Region, and *Lebinthus,* also known from the Philippine Islands and Amboina.

Lastly, the large family Podoscirtidae is well represented by species of *Madasumma, Mundeicus, Aphonoides* and *Euscyrtus,* more or less closely related to the Malayan species of the same genera; but the family also contains a few remarkable endemic genera such as *Hemiphonus, Hemiphonoides* and *Adenopterus.*

The following forms are particularly worth mentioning:

Anurogryllus australis Sauss. which seems unquestionably to belong to this South American genus has never been found again since its description.

Eugryllodes diminutus Walk. although presenting a few special features, shows no important difference from the species of this Mediterranean genus which is also represented by a Patagonian species. Such a geographical distribution is rather unusual and may simply be due to an insufficient knowledge of this genus.

A third very remarkable form is the genus *Cacoplistes*, a most extraordinary type of Grylloid, completely different from any other insect of the whole group; it deserves a special family for one or two Australian species and a third from Kashmir. It is obviously an archaic group now restricted to a few relics.

To sum up, with the exception of these special cases, we may say that the Australian Grylloidea are closely related to those of the Indo-Malaisian fauna with an important number of endemic genera. Unfortunately, the Papuan Grylloidea are so very insufficiently known that it is not possible to establish the exact relations between them and the Australian species.

Our knowledge of the Australian Grylloidea is still too fragmentary to allow any attempt at localization of species in this enormous continent with its different climates. The Queensland and Northern Territory seem pretty well known as also do New South Wales and Victoria. The case is quite different in South Australia and Western Australia, and in the deserts which are practically unknown.

Finally, it is not yet possible to speak of the ecological distributions of the Australian Grylloids. The material existing in the collections of the different Museums is mostly composed of old collections and provides very little information on this subject. Much remains to be done in this country, where such different biotopes may be encountered. We can only point out the presence of digging forms, the most remarkable of which is *Scapanonyx* with especially powerful spurs on the anterior tibiae adapted for this action. As usual in the Grylloidea, the majority of the species are rather hygrophilous insects.

The families Trigonidiidae and Oecanthidae and the genera *Ornebius* and *Euscyrtus* will be restricted in their choice of habitat as they must lay their eggs in the presence of those bushes and plants which grow in moist places.

KEY TO THE FAMILIES OF *GRYLLOIDEA*.

1. Second segment of tarsi compressed, minute 2
   Second segment of tarsi depressed 10
2. Posterior femora strongly swollen; general shape of body short, oval. Small myrmecophilous insects .. .. Myrmecophilidae
   Posterior femora moderately swollen; body more elongate 3
3. Posterior tibiae with serrulated margins, bearing no spines 4
   Posterior tibiae armed with spines 7
4. Facial shield subquadrate, inserted between the antennal sockets; frontal rostrum wide 5
   Facial shield transverse; frontal rostrum narrow 6

5. Facial shield strongly convex; small species with body more or less covered with scales; elytra of males membranaceous, short; females apterous .. .. Mogoplistidae

   Facial shield almost flat; body feebly pubescent, without scales; males and females with fully developed elytra .. .. .. Scleropteridae

6. Lateral margins of pronotum carinate. Posterior femora very slender. Ovipositor of female long, slender .. .. Cacoplistidae

   Lateral margins of pronotum rounded. Posterior femora less slender. Ovipositor of female wide, compressed .. .. .. Pteroplistidae

7. Posterior tibiae without denticles between the spines 8

   Posterior tibiae serrulate between the spines 9

8. Head globular; antennae inserted above the middle of the face Gryllidae

   Head flattened in front; antennae inserted beneath the middle of the face .. .. Pentacentridae

9. Head lengthened, horizontal; general shape slender; posterior femora long and feebly swollen .. .. Oecanthidae

   Head short, vertical; general shape more robust; posterior legs usually long with rather strongly swollen femora .. .. Phalangopsidae

10. Posterior tibiae non-serrulate, armed with 3 spines on each margin; small delicate insects .. .. Trigonidiidae

    Posterior tibiae serrulate between the spines 11

11. Posterior tibiae with long apical spurs, the externo-median longer than the other two; posterior metatarsi long 12

    Posterior tibiae with very short, nearly equal external spurs; posterior metatasi short .. .. Podoscirtidae

12. Head big with wide frontal rostrum .. .. .. Eneopteridae

    Head small with narrow frontal rostrum .. .. Itaridae

All the families except the Scleropteridae and Pteroplistidae are represented in the Australian fauna.

In this paper, I have not dealt with the Gryllotalpidae as these have been very carefully treated by Mr. Norman B. Tindale ("Australasian Mole-crickets of the family Gryllotalpidae (Orthoptera)", *Rec. S. Austr. Mus.*, IV, 1928, No. 1, 42 p.).

The Tridactyloidea (Trydactylidae, Cylindrachaetidae) have been recently recognized as having no direct affinities with the Grylloidea but are related more to the Acridioidae.

1. FAMILY GRYLLIDAE.

The family Gryllidae can be divided into two subfamilies, the Gryllinae in which the posterior tibiae are armed with strong, non-movable spines, and the Nemobiinae in which these spines are long, movable and hairy.

Subfamily GRYLLINAE.

The Gryllinae represent the most generalized type of gryllids; their general shape is rather stout with moderately long legs. The armature of the posterior tibiae is composed of long and strong spines which are not movable; there may be some small denticles before the spines but never between them; the second segment of the tarsi is small, compressed.

The number of species of Gryllinae is rather large and they are often difficult to separate. The genera themselves are not easily characterized and a certain number of species are more or less intermediate between two genera.

KEY TO GENERA OF *GRYLLINAE*.

1. Both sexes completely apterous 2
   Elytra more or less developed 3
2. Apical spurs of anterior tibiae much flattened, with cutting edges; ovipositor very short .. .. *Scapanonyx*
   Apical spurs of anterior tibiae not so wide; ovipositor rather long .. *Apterogryllus*
3. Posterior tibiae serrulate at base 4
   Posterior tibiae non-serrulate 5
4. Anterior tibiae perforated with a small internal tympanum; head very big; elytra of male without distinct mirror but with numerous oblique veins .. .. *Mjöbergella*
   Anterior tibiae non-perforated; head normal; elytra of male with very confused venation, showing no mirror or oblique veins .. *Copholandrevus*
5. Face flattened, chiefly in male .. .. *Loxoblemmus*
   Face convex in both sexes 6
6. Face strongly swollen; elytral venation very similar in both sexes .. *Cyrtoprosopus*
   Face regularly convex 7
7. Posterior femora longer than tibia and tarsus together 8
   Posterior femora shorter than tibia and tarsus together 9
8. Head very big, rounded .. .. *Cephalogryllus*
   Head normal .. .. *Anurogryllus*

9. Body depressed; elytra of male truncated at apex, without an apical field; elytra of female lateral; frontal rostrum rather narrow .. *Gryllodes*

Body more or less rounded; elytra of variable length, those of the male never truncated, with always visible apical field, even when reduced; frontal rostrum wider 10

10. Body strongly rounded; elytra of female short, often reduced to lateral pads .. .. *Gryllopsis*

Body less rounded; elytra of female more or less developed; never reduced to lateral pads 11

11. Elytra of male not remarkably ample; colouration more or less brownish .. .. *Gryllulus*

Elytra of male abnormally ample; colouration pale testaceous *Eugryllodes*

Gen. APTEROGRYLLUS Saussure 1877.

This genus is composed of two Australian species, one of which is described below. Both are apterous, with nearly cylindrical body and strong legs. They are allied to *Brachytrypes.*

KEY TO THE SPECIES OF *APTEROGRYLLUS.*

General shape more slender; pronotum smooth; labial palpi normally developed .. .. 1. *pedestris*

General shape more robust; pronotum rugose; labial palpi abnormally developed .. .. 2. *rugosus*

1. APTEROGRYLLUS PEDESTRIS Walk.

Brachytrypes pedestris Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 13.

Apterogryllus brunnerianus Saussure, 1877, Mem. Soc. Geneve., xxv, p. 109, pl. 14 (xxi), fig. 1–4.

Queensland: Mt. Tambourine (A. M. Lea). (S.A.M.). First described from North Australia, without exact locality.

2. APTEROGRYLLUS RUGOSUS sp. n.

♂ *Holotype.* A large and strong species, rufous brown with yellowish legs. Head a little narrower than pronotum in front, rounded; occiput and forehead rufous with a few tiny punctations; frontal rostrum about twice as large as first antennal segment. Face short and wide, yellowish; cheeks yellow. Antennae and palpi yellow; fourth segment of maxillary palpi shorter than third, fifth long, scarcely widened at apex which is slightly truncated; labial palpi very long, particularly the third segment, which is provided with long

bristles. Eyes small, very feebly projecting. Ocelli small, placed almost in a straight line, encircled with a rather large yellow spot.

Pronotum scarcely wider than long, rather strongly widened in front; anterior margin concave, bordered and slightly projecting through the presence of a rather deep furrow running along it; posterior margin also concave and bordered; disk rather strongly convex; depressed along the median line and the posterior margin, with two deep impressions in front of the usual piriform impressions; nearly its whole surface is rendered rugose by a tiny net of small crooked ridges; lateral lobes rather high, yellowish, also somewhat rugose, their inferior margins narrowly brownish, slightly ascending backwards; anterior angle rounded, posterior one quite obliterated. Meso-,metanotum and first abdominal tergite wrinkled. Abdomen rufous above, a little shining with darkened median line; sides and inferior part yellowish; superior anal valve long, a little narrowing towards the apex which is truncated; sub-genital plate compressed. Cerci yellow, long and slender.

Legs short and strong, yellowish, a little pubescent. Anterior tibiae non-perforated, armed with 3 apical spurs; tarsi short, particularly the metatarsus. Median tibiae armed with 4 apical spurs. Posterior femora long but rather thick; tibiae short, armed with 5 spines on each superior margin, the internal ones much the longer; apical spurs strong, the supero-internal one much longer than the median. Metatarsi rather long, strong, compressed, furrowed above and armed with 5–6 denticles on each margin, their apical spurs strong but rather short.

♀ *Allotype.* Absolutely similar to the male except for the pronotum which is less widened in front. Ovipositor long and slender, with very narrow apical valves; these are strongly carinated, the superior ones feebly acute, the inferior shorter and slightly truncated at apex.

Length of body 33 mm.; pronot. ♂ 9 mm., ♀ 8 mm.; post. fem. 21·5 mm.; post. tib. 12 mm.; ovipositor 25 mm.

This species is much more robust than the preceding one and differs from it in numerous characters, particularly in the wrinkles of the pronotum and the very long labial palpi which remind one of *Scapanonyx palpatus*. It is intermediate between both genera, but the spurs of the anterior tibiae are not especially flattened and the shape of the ovipositor is very different.

Northern Territory: Darwin 2 ♂, 2 ♀; Groote Eylandt (N. B. Tindale), 1 ♀ (S.A.M.).

Types: Northern Territory, Darwin, 1 ♂, 1 ♀.

Gen. SCAPANONYX Chopard, 1925.

This genus was erected for a remarkable species allied to *Apterogryllus* but differing from it in the strongly flattened and widened apical spurs of the anterior tibiae.

SCAPANONYX PALPATUS Chopard, 1925.

Scapanonyx palpatus Chopard, 1925, Ark. f. Zool., 18 A, No. 6, p. 10, fig. 12–17.

South Australia: Ooldea (A. M. Lea), 2 ♀ ; Lake Callabonna (Lake Mulligan), 1 ♀ larva. (S.A.M.).

This species was previously known from the type only, which was described from Derby, N.W. Australia, and belongs to the Stockholm Museum.

Northern Territory: Darwin, 1 ♂ larva (S.A.M.).

Gen. CEPHALOGRYLLUS Chopard, 1925.

This genus belongs also to the *Brachytrypes* group; the head is very big, rounded; the posterior femora long and feebly swollen at base, the posterior tibiae relatively short, with supero-internal apical spur longer than the median; the male elytra are shorter than abdomen, with very short apical area, mirror usually reduced to a large transverse cell.

This genus can be considered as the Australian representative of the Indo-Malaisian genus *Gymnogryllus*.

KEY TO THE SPECIES OF *CEPHALOGRYLLUS*.

1. Mirror rather large, rounded; apical area of male elytra moderately developed .. .. 1. *australicus*
   Mirror small, strongly transverse; apical area very much reduced .. 2
2. Size medium; head brown; 5 oblique veins on the male elytron 2. *laeviceps*
   Size smaller; head rufous; 2 oblique veins .. .. .. 3. *ruficeps*

1. CEPHALOGRYLLUS AUSTRALICUS sp. n.

Fig. 1, 17.

♂. Size rather large; brownish, a little pubescent. Head as wide as pronotum in front, rounded, shining brown with a longitudinal yellow band behind each eye; frontal rostrum wide; ocelli circled with yellow. Face rather long, rufous; clypeo-frontal suture very feebly convex in the middle; cheeks rufous. Antennae and palpi brown; fourth segment of maxillary palpi shorter than third, fifth very large, feebly enlarged at apex which is strongly and obliquely truncated.

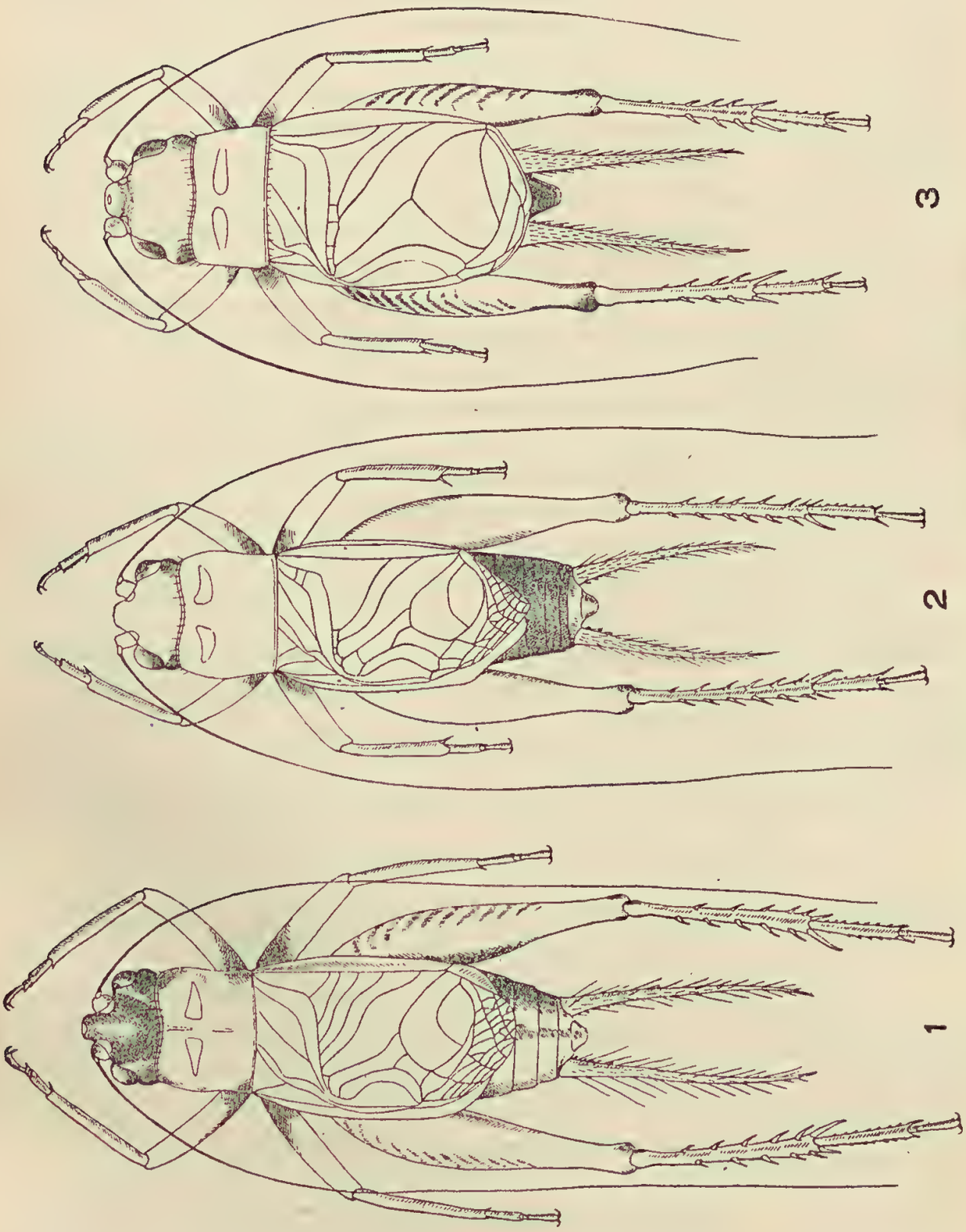


Fig. 1. *Cephalogryllus australicus* sp. n. ♂. Fig. 2. *Anurogryllus australis* Sauss., ♂.
Fig. 3. *Eugryllodes diminutus* Walk., ♂.

Pronotum with parallel sides; anterior margin concave; posterior one straight; disk feebly convex, brown, pubescent, the piriform impression rufous; lateral lobes yellowish with brown inferior margin; this margin is straight with rounded angles. Abdomen rufo-testaceous with a median brown band above. Cerci long, rufous. Genitalia forming a wide superior bridge without any median projection, the angles rather propecting, somewhat rounded at apex (fig. 17).

Legs rather long, rufous, with darkened tibiae. Anterior tibiae perforated on external face only with a large oval tympanum. Posterior femora relatively long, but rather strong, with external face striated with brown. Posterior tibiae rather short, armed with 5 short, curved spines on each margin; apical spurs strong but short, the supero-internal one longer than the median; metatarsi long, armed with 8 denticles on each margin.

Elytra a little shorter than abdomen, brownish, finely pubescent; mirror obliquely oval, divided beneath the middle by a curved vein; 5 rather regularly spaced oblique veins; chords strongly curved, united to the mirror by a small vein; apical field with 3 sectors, rather regularly reticulated in long narrow cells. Wings very short.

Length of body 22 mm.; pronot. 4·5 mm.; post. fem. 16 mm.; post. tib. 9·5 mm.; elytra 11·5 mm.

This species is not so characteristic as the other two species of the genus; it could as well be considered as a *Gymnogryllus* with shortened elytra; the shape of the genitalia is very similar to that of the following species showing that they are narrowly related.

Type: Queensland, Kuranda (Hale and Tindale, Dec. 1926), 1 ♂ (S.A.M.).

2. CEPHALOGRYLLUS LAEVICEPS Chopard, 1925.

Cephalogryllus laeviceps Chopard, 1925, Ark. f. Zool, 18 A, No. 6, p. 12, fig. 18.

Fig. 18.

This male is a little smaller than the type (length of body 15 mm.), its head is smaller and the elytral mirror is not divided. The genitalia are very much like those of the preceding species, the angles of the superior bridge being a little longer and narrower (fig. 18).

Queensland: Mt. Tambourine, Herberton, 1 ♂ (S.A.M.).

3. CEPHALOGRYLLUS RUFICEPS sp. n.

A rather small rufous brown species. Head big, round, rufous, shining; frontal rostrum short and very wide. Face rather short, wide, yellowish;

clypeo-frontal suture low but slightly angulate; cheeks yellowish, very finely wrinkled beneath the eyes. Eyes flattened, round; ocelli small, yellow, disposed in a straight line. Antennae and palpi yellowish; fourth segment of maxillary palpi equalling the third, fifth longer, scarcely enlarged at apex, which is obliquely truncated.

Pronotum transverse, feebly enlarged in front, with anterior margin a little concave, posterior margin straight; both are provided with brown bristles; disk weakly convex, rufous brown, darker than the head, furnished with a whitish recumbent pubescence; lateral lobes yellowish, with inferior margin straight, anterior angle nearly a right angle, posterior one rounded. Abdomen brown above, yellowish beneath. Cerci rufous.

Legs light rufous, rather short. Anterior tibiae perforated at external face with a rather large long oval tympanum; their apices armed with 3 spurs, of which the two internal are strong; metatarsi rather long, compressed, armed beneath with two rows of spinules.. Posterior femora long and rather narrow; tibiae rather short, armed with 6 spines on each margin; infero-external and supero-external apical spurs shorter than the external, the two long ones nearly equal in length; metatarsi long, compressed, armed with 7 to 8 denticles on each superior margin and two rather strong apical spurs.

Elytra greyish, extending to the apex of abdomen, rounded; mirror quite reduced to a long and narrow cell formed by the prolongation of the diagonal vein; behind this cell, there is a short apical area comprising a few very large, irregular cells; chords long and close, very near to the diagonal vein; 2 oblique veins, the first of which strongly bent at a right angle, second almost straight; lateral fields light, with 4 plain, regularly spaced veins. Wings quite atrophied.

Length of body 10 mm.; post. fem. 7 mm.; elytra 5·5 mm.

By the shape of the much reduced mirror, this species is related to *laeviceps*, but the oblique veins are 2 only in number and the apical field is divided into very large cells. The size seems rather variable as an example from Port Darwin, in the British Museum collections, is 14 mm. long.

Northern Territory: Port Darwin (Br. M.); Adelaide River (Br. M.).

Type: Northern Territory: Darwin (G. F. Hill), 1 ♂. (S.A.M.).

Gen. ANUROGRYLLUS Saussure 1877.

This genus is characterized by the extreme shortness of the ovipositor. It is an American genus in which Saussure placed an Australian species only known from a single male. Although this insect looks really very much like an *Anurogryllus*, it is difficult to ascertain its generic position until the female is known. I leave it temporarily in the present genus.

ANUROGRYLLUS AUSTRALIS Saussure, 1877.

Anurogryllus australis Saussure, 1877, Mem. Soc. Geneve, xxv, p. 285.

Fig. 2, 19.

The type specimen is in the Paris Museum; it is labelled "Nouvelle Hollande" without any exact locality. It looks rather like *Anurogryllus muticus* from South America, but its elytra are shorter. It is quite different from the other Australian species of the group *Brachytrypes.* The genitalia are long and narrow, acute and divided at apex (fig. 19).

Gen. GRYLLULUS Uvarov, 1935.

This genus comprises species of Gryllids with the following features: body more or less convex, but not rounded above, pubescent; elytra as long as the abdomen or more or less reduced, but never lateral, pad-like; posterior femora shorter than the tibia and tarsus together; supero-internal apical spur of posterior tibiae usually shorter than the median; ocelli disposed in a triangle.

The species of the genus *Gryllulus* are numerous and very difficult to name with certainty. As a matter of fact this is almost impossible in the female sex; in the males, the elytral venation and the shape of the copulatory organs give very good characteristics. The following key, based in part on characters of colouration, is to be considered only as an attempt in the study of this difficult genus.

KEY TO THE SPECIES OF *GRYLLULUS.*

1. Size medium or large (14–30 mm.) 2
   Size smaller (10–12 mm.) 14
2. Head and pronotum uniformly rufous brown 3
   Head and pronotum of a different colour 4
3. Clypeo-frontal suture angulate; apical field of male elytron present, finely reticulated; elytra of female long .. .. .. 6. *fulviceps*
   Clypeo-frontal suture bent; apical field of male elytron almost absent; elytra of female very short .. .. 18. *laticaput*
4. Head with a yellow band between the eyes; pattern usually very obvious 5
   Head without a yellow band between the eyes (sometimes a rufous line); pattern very weakly marked 7
5. General colouration testaceous; occiput without longitudinal light lines .. .. 1. *domestica*
   General colouration darker; occiput presenting usually short light lines 6

6. Head large; clypeo-frontal suture low, feebly angulate .. .. 5. *lineiceps*
Head small; clypeo-frontal suture angulate, extending higher than the inferior level of antennary sockets .. .. 4. *lepidus*

7. Large or rather large species (15 to 30 mm.) with head and pronotum dark brown; clypeo-frontal suture nearly straight; male elytra with 3–4 oblique veins 8
Smaller species, no more than 14–16 mm. in length 9

8. Larger (20–30 mm.) .. .. 2. *commodus*
Smaller (15–20 mm.) .. .. 3. *oceanicus*

9. Elytra extending to the apex of abdomen 10
Elytra strongly shortened 11

10. Clypeo-frontal suture reaching the anterior ocellus; forehead strongly swollen .. .. 8. *scutellatus*
Clypeo-frontal suture not over-reaching the middle of antennary sockets; forehead normal .. .. 7. *comparatus*

11. Mirror of male rhomboid 12
Mirror of male subtriangular 13

12. Head comparatively long; clypeo-frontal suture nearly straight .. 10. *flavispina*
Head shorter, orbicular in shape; clypeo-frontal suture angulate .. 9. *fistulator*

13. Mirror of male not divided .. .. 11. *diminuens*
Mirror of male divided; elytra short and wings long 12. *curtipennis*

14. Head with very distinct pattern 15
Head uniformly blackish or with indistinct pattern 17

15. Clypeo-frontal suture feebly arched .. .. .. 13. *parvulus*
Clypeo-frontal suture rather strongly bent 16

16. General colouration testaceous brown .. .. .. 14. *minusculus*
General colouration black .. .. 15. *subniger*

17. Clypeo-frontal suture very low, scarcely arched .. .. 16. *mediocris*
Clypeo-frontal suture very strongly angulate .. .. 17. *kempi*

1. GRYLLULUS DOMESTICUS (L.).

Gryllus (*Acheta*) *domesticus* Linné, 1758, Syst. Nat. ed. x, i, p. 428.

This species can now be recorded from Australia, where it seems to have been introduced recently. The special conditions in which it was found are not surprising as they had been previously observed in England and in

France. Such conditions allow this very thermophilous species to breed out of doors under relatively cold climates.

South Australia: Adelaide (Commonwealth Inst. Ent.); from rubbish dump.

2. GRYLLULUS COMMODUS (Walk.).

Gryllus commodus Walker, 1869, Cat. Derm. Salt. B.M., i, p. 45; Chopard, 1925, Ark. f. Zool., 118A, No. 6, p. 13.

Gryllus fuliginosus Serville (*nec* Stoll), 1839, Ins. Orth., p. 334.

Gryllus Servillei Saussure, 1877, Mem. Soc. Geneve, xxv, p. 156.

Fig. 20, 21.

This is the most common species of *Gryllulus* in Australia. The head and pronotum are blackish, usually without any ornament; the male genitalia (fig. 20–21) are hollowed above in the shape of a groove.

Queensland: Brisbane, Ebor, 4,000 ft. (Q.M.), Cooktown (Br. M.); North West Is., (A.M.); Glen Laminton, Bellenden Ker, Brisbane, Yarrabah (Stockholm M.); Dunk Is., Mt. Tambourine, Kuranda, Magnetic Is., Cape Yorke Pen., Cairns Dist., Bellenden Ker, (S.A.M.).

Northern Territory: Groote Eylandt, Daly River, Port Darwin, Koolpinya, Tennants Creek, (S.A.M.); Groote Eylandt (A.M.).

Western Australia: Wyndham (S.A.M.).

South Australia: Wittunga (Blackwood), swarming in pasture April, 1948 (Commonwealth Inst. Ent.); Grange, Lake Mulligan (Callabonna), Patawalonga, Croydon, Blakiston, Willunga, Hindmarsh Valley, Dawlingville, Mt. Laffer, Torrens Creek, Stirling North, Pt. Pirie, Kangaroo Is., (S.A.M.).

New South Wales: Nowra (Br. M.); W. Sydney, Homebush, Eastwood, Brooklana, E. Dorrigo, (A.M.); Clarence R., Sydney, (S.A.M.).

Tasmania: Table Cape (S.A.M.).

Norfolk Is.: Lord Howe Is. (S.A.M.); Capricorne Is. (Br. M.).

3. GRYLLULUS OCEANICUS (Le Guil.).

Gryllus oceanicus Le Guillou, 1841, Rev. Zool., p. 293.

Gryllus innotabilis Walker, 1870, Cat. Derm. Salt., i, p. 92.

This species is perhaps mainly an insular race of the preceding one; it does not appear to occur commonly in Australia but is very widespread in Oceania.

South Australia: Glenelg, Blakiston, Patawalonga, Kangaroo Island (S.A.M.).

Northern Territory: Melville Island (S.A.M.).

4. GRYLLULUS LEPIDUS (Walk.).

Gryllus lepidus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 40; Chopard 1925, Ark. f. Zool, 18A, No. 6, p. 13.

Gryllus kimberleyensis Mjöberg, 1913, Ent. Tidskr., xxxiv, p. 32.

Gryllus lepidoides Chopard, 1915, Nova Caledonia, Zool., ii, 8, p. 138.

Fig. 22.

This species is smaller than the preceding ones; it is characterized by its shining aspect, head always adorned with a narrow transverse yellow band and 5 lines of the same colour on the occiput; the clypeo-frontal suture is angulate, extending to the inferior margin of antennal sockets. In the male the elytra has 2 oblique veins. Genitalia with rounded superior lobes, inferior ones denticulated (fig. 22). The average size is 15 mm. but some individuals reach 18 mm. As in many species of the genus a short-winged and a long-winged form are found.

Very common in Australia and in Oceania.

South Australia: Ardrossan, Lake Mulligan (Callabonna), Mt. Lofty, Devon Downs, Kangaroo Island, Adelaide, Owieandana, Northern Flinders Ranges, Largs Bay, Murray Bridge, Oodnadatta, Cooper's Creek, Wookooloo, Innamincka, Red Cliffs, Wilpena Pound, Minnie Downs, Mt. Bryan, Semaphore, Stirling North, Kingoonya, Renmark, (S.A.M.); Mt. Lyndhurst Station, Farina (A.M.); Avenue (Browning, ii, 1949), (Com. Inst. Ent.); Alexandria (Br. M.).

Queensland: Mt. Tambourine (Q.M.); Cunnamulla, Powella Aramack, Michaelmas Cay off Cairns (A.M.); Mt. Tambourine (S.A.M.).

Northern Territory: Tennant Creek, Darwin, Charlotte Waters, Alice Springs, Batchelor (S.A.M.).

Central Australia: Hermannsburg (Br. M.); Carawena (S.A.M.).

Western Australia: Derby (Stockholm Mus.); Fitzroy and Margaret Ranges Area; Derby, Darling Ranges, Beverley (S.A.M.); Noonkanbah (Stockholm Mus.).

New South Wales: Nowra (Br. M.); Wentworth, Clarence River (S.A.M.); Taree, Eastwood, Florida North Moree, Myall Lakes, Sydney (A.M.).

Norfolk Island (S.A.M.).

5. GRYLLULUS LINEICEPS (Walk.).

Gryllus lineiceps Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 44.

Fig. 23.

Although this species was described from an immature female the special ornamentation of the head allows us to recognize it with certainty.

The description may be completed as follows:

♂. Head big, adorned with 6 yellow lines on the occiput, the two external ones uniting on each side in the ocular angle; a rather narrow yellow band unites the eyes above the antennal socket; frontal rostrum very wide. Face rather short, brownish; clypeo-frontal suture subangular but rather low, not exceeding the inferior level of antennal sockets. Palpi yellowish; fifth segment of maxillary palpi brownish, with very obliquely truncated apex. Pronotum slightly enlarged in front; disk nearly flat, brownish with a few testaceous spots; lateral lobes yellowish. Abdomen brown above, yellowish beneath; tenth tergite and anal valves rufous. Genitalia with trilobate superior piece, the median lobe shorter than the lateral ones, convex at top (fig. 23). Legs short, yellowish brown, pubescent. Anterior tibiae non-perforated at internal face. Posterior femora thick, with external face striated with brown; tibiae armed with 5 spines on each side. Elytra extending to the apex of sixth abdominal tergite; mirror in the shape of a transverse lozenge; diagonal vein long, a little sinuated; 2 oblique veins; chords rather strongly sinuated, the first one sending out a veinlet near the angle of the mirror; apical field very short, divided into long, narrow cells; lateral field dark brown in its superior part, with 5 regularly and feebly spaced veins, Sc with one branch. Wings quite abortive.

Length of body 16 mm.; post. fem. 10·5 mm; elytra 8 mm.

♀. Similar to the male, with smaller head. Ovipositor rather short, with apical valves flat, blunt. Elytra extending only to the apex of the first abdominal tergite, brown with a yellow band on the edge; dorsal field with 4 veins and the cubital which is furcate.

Length of body 14·5 mm.; post. fem. 9·5 mm.; elytra 3·5 mm; ovipositor 8 mm.

6. GRYLLULUS FULVICEPS (Mjöb.).

Gryllodes fulviceps Mjöberg, 1913, Ent. Tidskr., xxxiv, p. 33; Chopard 1925, Ark. f. Zool., 18A, No. 6, p. 15, fig. 21–22.

Fig. 24.

This species is well characterized by its uniformly rufous colouration and its silky whitish pubescence. The head presents no ornamentation; clypeo-

frontal suture strongly angulate, extending to the middle of the antennal sockets; frontal rostrum wide, with carinate sides. Disk of pronotum a little darkened in the middle and near the anterior margin; lateral lobes yellow with a brown band in the superior part, which does not reach the anterior margin. Elytra of male extending to the apex of abdomen, somewhat rufous, lateral field with a narrow brown band along the superior edge, and showing traces of division in its posterior part; 2 oblique veins; apical field short, rounded, rather irregularly reticulated; lateral field with parallel, close veins; Sc plain. Genitalia of the same type as in *lepidus*, the inferior part forming two long teeth crossing on the median line (fig. 24). In the female, the elytra are brownish above, a little shorter than abdomen, rounded at apex; dorsal field with a dozen veins which are feebly oblique, regularly and weakly spaced; transverse veinlets numerous, forming small areolae. Ovipositor rather short (10 mm.), with feebly acute, wide apical valves. Wings long, whitish with anterior part brown in both sexes.

Queensland: Winton (S.A.M.).

South Australia: Lake Mulligan (Callabonna), (S.A.M.); Alexandria (Br. M.).

New South Wales: Moree (A.M.).

North Western Australia: Noonkanbah, W. Kimberley (types in the Stockholm Museum).

7. GRYLLULUS COMPARATUS (Walk.).

Gryllus comparatus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 44.

Fig. 25.

This species is of medium size (14–15 mm.), blackish, shining. Head with 6 short yellow lines on the occiput; a very narrow interocular band; clypeo-frontal suture subangulate but rather low, extending only to the inferior level of antennal sockets. Anterior tibiae with internal tympanum small or absent; posterior tibiae armed with 5 spines on each margin. Elytra of male extending to the apex of abdomen, testaceous; mirror a little transverse, with rounded angles, not divided; 3 oblique veins (2 only in Walker's type); apical field long, with irregular, rather close reticulation; lateral field for the most part whitish, with close veins. Genitalia with a wide median projection, long, narrow lateral lobes (fig. 25). Elytra of female as long as in male, testaceous with feebly oblique veins, rather regular, close reticulation. Ovipositor rather long (11 mm.) with flat, little acute apical valves. Wings caudate in both sexes.

South Australia: Lake Mulligan (Callabonna), Callington, Cooper's Creek (S.A.M.).

Queensland: Powella Aramack (A.M.); Ebor, 4,000 ft. (Q.M.).
Northern Territory: Groote Eylandt (Br. M.); Charlotte Waters (S.A.M.).
Victoria: Wimmera, Healesville (Q.M.).
New South Wales: Jenolan (A.M.).
Lady Musgrave Island (Br. M.).

8. GRYLLULUS SCUTELLATUS sp. n.

Fig. 26.

Medium sized species, shape somewhat depressed. Head chestnut brown or blackish with 6 yellowish lines on the occiput; these lines are more or less united by a transverse band; there exists also a narrow interocular band which is sometimes completely obliterated in the middle. Face short and wide, with remarkably swollen facial shield, with a weak longitudinal median furrow; clypeo-frontal suture strongly angulate, extending as far as the anterior ocellus. Anterior tibiae perforated on external face only; posterior tibiae armed with 5 spines on each margin. Elytra extending to the apex of abdomen, light yellowish brown; mirror of the male nearly square, with right angles, not divided; 2 oblique veins; apical field rather large, with 2 sectors only and a rather wide reticulation; lateral field nearly black, with close veins. Genitalia with superior part trilobate, the median lobe short with rounded apex (fig. 26). Elytra of female with rather regular venation; Cu trifurcate. Ovipositor with flat, little acute, apical valves. Wings caudate in both sexes.

Length of body 14 mm.; post. fem. 9·5 mm.; elytra 9 mm.; ovipositor 8·5 mm.

This species is very close to *comparatus* but easily distinguished by the shape of the facial shield. The colouration is somewhat variable, some individuals being lighter with wider interocular band and the occipital lines more or less united. The male genitalia are quite of the same type as in *comparatus* but in this species, the median lobe is wider with acute angles at top and the inferior lobes are rounded without a small apical tooth (fig. 26).

South Australia: Lake Mulligan (Callabonna), (S.A.M.), type ♂ and ♀).
Central Australia: Higgin Dam (S.A.M.).

9. GRYLLULUS FISTULATOR (Sauss.).

Gryllodes fistulator Saussure, 1877, Mem. Soc. Geneve, xxv, p. 212.

Size medium (14–16 mm.). Head dark brown, with no distinct ornamentation except a yellow spot between the eyes and the ocellus; clypeo-frontal suture strongly bent, subangular, reaching the inferior level of antennal sockets.

Elytra of male extending to the apex of the sixth abdominal tergite; mirror in the shape of a wide lozenge, with obtuse anterior angle, not divided; 2 oblique veins; no veinlet between the first chord and the mirror; apical field very short (Saussure). Elytra of female extending to the apex of third abdominal tergite, with oblique internal margin; dorsal field with 4 veins and the cubital which is bifurcate; transverse veinlets close and more or less anastomosed; veins of the lateral field close. Ovipositor rather long (10 mm.) with flat, little acute apical valves.

This species is a little depressed with short lateral lobes of the pronotum; the macropterous form is not known. I have seen no male specimen.

Victoria: Melbourne (Saussure's type in Brunner's collection); Healesville distr. (Q.M.).

South Australia: Hindmarsh Valley, Murray R., Nuriootpa (S.A.M.).

10. GRYLLULUS FLAVISPINA (Sauss.).

Gryllodes flavispina Saussure, 1877, Mem. Soc. Geneve, xxv, p. 213.

According to Saussure's description, this is very close to the preceding species but with more lengthened head; mirror of the male nearly triangular with very acute anterior angle, the posterior part a little reticulated; there is a veinlet between the first chord and the diagonal vein and two between the chord and the mirror; lateral field with veins more spaced. I may add that the clypeo-frontal suture is almost straight. Prahamtown (Saussure's type in Brunner's Collection).

Northern Territory: Port Darwin, vii (Br. M.).

11. GRYLLULUS DIMINUENS (Walk.).

Gryllus diminuens Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 43.

This species, 14 mm. long, seems close to the preceding ones. It is shining black, the head almost without any ornamentation; pronotum black with a narrow brownish band in front. Elytra a little more than half the abdomen in length, almost straightly truncated; mirror of male a little transverse, not divided; 2 oblique veins. The type is a micropterous specimen with no internal tympanum on anterior tibiae.

Tasmania (Walker's type).

12. GRYLLULUS CURTIPENNIS (Mjöb.).

Gryllodes curtipennis Mjöberg, 1913, Ent. Tidskr., p. 33; Chopard, 1925, p. 14, fig. 20.

A little larger than the preceding species (17 mm.); elytra of male a little shorter than the abdomen (8·5 mm.) with well developed apical field; mirror rhomboidal, a little longer than wide, divided by a strongly bent vein.

This species, of which the macropterous form only is known, is remarkable by its long wings and relatively short elytra, with nevertheless a comparatively large apical field.

North West. Australia: W. Kimberley, Noonkanbah, Derby (Mjöberg's type in the Stockholm Museum).

13. GRYLLULUS PARVULUS (Walk.).

Gryllus parvulus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 43.

Fig. 27, 31.

This species is smaller than the preceding ones (11 mm.). Head rather large, shining brown, with a rather narrow but very neat yellow band between the eyes; frontal rostrum wide, feebly projecting. Face wide; clypeo-frontal suture feebly bent, rounded in the middle. Elytra of male (fig. 31) scarcely reaching the abdominal extremity, with very short apical field, composed of a few large cells; mirror small, in the shape of a rather regular oblique parallelopiped; 2 oblique veins; diagonal vein long, close to the chords which are rather strongly bent. Wings very short. Genitalia with superior part trilobate, the median lobe with somewhat notched apical edge (fig. 27). According to Walker, the elytra of the female cover two-thirds of the abdomen; they present a testaceous band on the edge; ovipositor as long as the abdomen.

New South Wales: Upper Williams R. (S.A.M.).

14. GRYLLULUS MINUSCULUS (Walk.).

Gryllus minusculus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 47.

Fig. 28, 32.

Very close to the preceding species; general colouration lighter, head chestnut brown with a yellow band between the eyes and 6 lines of the same colour on the occiput, the two median of which are short, the others uniting near the eye; frontal rostrum very wide, short. Face short and wide, rather

strongly swollen; clypeo-frontal suture exceeding the inferior level of the antennal sockets. Palpi yellow; 5th segment of maxillary palpi a little darkened at apex. Legs yellowish varied with brown; anterior tibiae perforated on the external face only; posterior tibiae armed with 5 spines on each margin; posterior metatarsi with 6 denticles on each superior margin. Abdomen brownish. Cerci yellow. Genitalia of the same type as in the preceding species but with much more slender median lobe (fig. 28). Elytra (fig. 32) a little shorter than the abdomen, with short apical field, reticulated in small cells; mirror larger than in *parvulus*, with more rounded angles; 2 oblique veins; lateral field with rather close veins. Wings wholly abortive. In the female the ovipositor is rather long (10 mm.) with somewhat flat but acute apical valves.

Length of body 12 mm.; post. fem. 7·5 mm.; elytra 7 mm.

This speceis has a macropterous form. Its general aspect is somewhat that of a small *Gryllulus domesticus*.

South Australia: Murray River, under stones (S.A.M.).

Queensland: Bunya Mts. (Q.M.).

Northern Territory: Adelaide River (Br. M.).

15. GRYLLULUS SUBNIGER sp. n.

Holotype: ♂. Very close to *nanus* in the general shape, size, elytral venation and genitalia, but quite different in colouration. Head black shining, with a narrow, very neat, yellow band between the antennae; occiput with 6 very short and feebly marked yellow lines; cheeks with a yellow spot behind the eye. Face short and wide; clypeo-frontal suture strongly bent, subangular, somewhat overreaching the inferior level of the antennal sockets. Pronotum black, shining, very feebly enlarged in front, with anterior margin very feebly convex, posterior margin straight; disk almost flat; lateral lobes black spotted with yellow in the anterior angle. Abdomen black, finely pubescent. Legs blackish; posterior femora short and stout, a little striated with yellow on the external face; internal face yellow at base and towards the inferior margin; tibiae armed on each margin with 5 rather strong, rufous spines. Elytra extending to the apex of the 7th abdominal tergite, black, rounded at apex; mirror a little transverse, with rounded posterior angle; 2 oblique veins; apical field very short; lateral field partly whitish, with 5 close veins and one branch to the Sc. Wings very short.

Allotype: ♀. Very similar to the male in general shape and colour; a little larger; head with transverse yellow band and occipital lines almost completely obliterated. Elytra short, extending to the apex of the 2nd abdominal

tergite, with internal margin oblique; dorsal field brown with a light humeral band; 5 longitudinal, rather irregular and anastomosed veins; lateral field whitish for the greater part, with 5 regularly spaced veins; Sc plain. Ovipositor rather short and stout, with apical valves depressed, blunt at apex.

Length of body ♂ 12 mm., ♀ 14 mm.; pronot. ♂ 2·6 mm.; ♀ 3 mm.; post. fem. ♂ 7·6 mm., ♀ 8·2 mm.; elytra ♂ 5·1 mm., ♀ 4 mm.; ovipositor 8·5 mm.

Types: South Australia: Avenue (T. O. Browning, 29, ix, 1949), 1 ♂; Glen Osmond (T. O. Browning, 29, ii, 1949), 1 ♀ (Commonwealth Inst. Ent.).

16. GRYLLULUS MEDIOCRIS (Mjöb.).

Grylloides mediocris Mjöberg, 1913, Ent. Tiskr., p. 33.

Gryllus mediocris Chopard, 1925, Ark. f. Zool., p. 15, fig. 19.

Fig. 29.

Close to *parvulus;* rather dark brown; head smaller, shining black with feebly marked ornamentation, consisting of 6 short yellow lines on the occiput; clypeo-frontal suture very low, scarcely bent. Genitalia wide and short, the superior part trilobate (fig. 29). The elytra can be shortened as in Mjöberg's type or extending to the apex of abdomen. Ovipositor rather long (7·5 mm.) with narrow acute apical valves.

Queensland: Cape Yorke, Cedar Creek, Bellenden Ker, Atherton, Yarrabah, Laura, Alice River (Mjöberg); Kuranda, Magnetic Is., Cairns Dist. (S.A.M.).

North West. Australia: Noonkanbah, W. Kimberley (Mjöberg's types), (Stockholm Mus.).

Northern Territory: Roper River (S.A.M.).

Karamula Is., Russell Group (S.A.M.).

17. GRYLLULUS KEMPI sp. n.

Fig. 30, 33.

Holotype. ♂. Small; uniformly chestnut brown. Head round, shining, with only traces of yellow lines on the occiput. Face rather long; clypeo-frontal suture very strongly angulate, extending to the middle of antennal sockets. Palpi yellowish. Pronotum transverse, with feebly concave anterior margin; lateral lobes with yellowish anterior angle. Abdomen brown above, yellowish beneath. Ovipositor with apical valves little acute, somewhat depressed. Legs yellowish varied with brown; anterior tibiae perforated on external face with a large oval tympanum. Posterior tibiae armed with 6

external, 5 internal spines. Elytra (fig. 33) dark testaceous, scarcely reaching the apex of abdomen, rounded at apex; dorsal field with somewhat irregular, rather close veins; lateral field brown, with 5 close veins. Wings long, whitish. Genitalia with superior part trilobate, the lobes long and narrow (fig. 30).

Length of body 10 mm.; length with wings 15·5 mm.; post. fem. 6 mm.; elytra 6·2 mm.; ovipositor 6 mm.

Allotype: ♀. Elytral mirror lozenge-shaped, a little longer than wide, with anterior and internal angles straight or nearly so; posterior angle acute but somewhat rounded, exterior angle obtuse; infero-internal side longer than the others; 2 oblique veins; chords parallel, separated to the base; apical field rather long, with 5 sectors and a rather irregular, wide reticulation; lateral field brown, with close veins, Sc furcate. Genitalia of the same type as the preceding species, with median lobe long and narrow (fig. 30).

This species is close to *mediocris*, but smaller with less acute ovipositor, strongly angulate clypeo-frontal suture.

Types: Queensland: Normanton (R. Kemp), 1 ♀ (A.M.). North West. Australia: (Dr. H. Basedow), 2 ♂, Derby (Plesiotype).

18. GRYLLULUS LATICAPUT sp. n.

Holotype: ♂. Medium sized species, of light rufous general colouration. Head wide; occiput shining chestnut brown; frontal rostrum short, wide; a rather narrow yellow band between the ocelli. Face yellow, especially short and wide, the cheeks strongly projecting; clypeus very wide, short on the sides; clypeo-frontal suture extending to the inferior level of the antennal sockets. Antennae and palpi yellow. Pronotum somewhat widening in front, with rather concave anterior margin; disk almost flat, rufous brown with yellowish anterior and posterior margins; lateral lobes yellow with brown inferior margin. Abdomen brownish above, yellowish beneath. Cerci yellowish. Genitalia of the *comparatus* type with very short, truncated median lobe (fig. 25).

Legs yellowish; anterior tibiae armed with 3 long and slender apical spines, perforated with a large external tympanum. Posterior femora thick, feebly striated with brown at external face; tibiae armed with 6 internal, 7 external long spines; apical spurs long, the medio-external one quite twice as long as the other two, the two large internal ones subequal in length; posterior metatarsi long, armed with 7–8 denticles above.

Elytra extending nearly to the apex of abdomen, brownish with a yellow band on the edge, very feebly pubescent. Mirror small, strongly transverse, with obtuse anterior angle, posterior angle rounded, lateral angles acute; divid-

ing vein situated much before the middle, almost parallel to the anterior margins; 2 oblique veins; diagonal vein long, curved; chords long, close, a little nearer in the middle; apical field very short, with 2 sectors and few very small irregular cells. Lateral field yellow, with close veins, Sc simple. Wings abortive.

Allotype: ♀. Elytra very short, with strongly oblique apical margins; dorsal field with 5 irregular veins which are feebly visible near the base; lateral field wide, yellow. Ovipositor long with somewhat flattened, little acute apical valves.

Length of body 16 mm.; post. fem. 10·5 mm.; elytra ♂ 8·5 mm., ♀ 3 mm.; ovipositor 11·5 mm.

This species has very much the general aspect of *Gryllulus fulviceps*. It is more shining, the male with much shorter apical field of the elytra and a quite different type of genitalia; the female has much shorter elytra. This last character somewhat resembles that of the next genus, but the rather depressed shape of the body is that of *Gryllulus*.

Types: Queensland: 23 miles S.W. of Dajarra (T. Hodge-Smith, Sept., 1930), 1 ♂, 1 ♀ (A.M.).

NOTES.

1. A species, common in Indomalaya and Papua, *Gryllulus blennus* Saussure is also found in North Australia. It is close to *mediocris*, with head and pronotum uniformly chestnut brown and veins of the lateral field of elytra more distant; the genitalia of the male are also somewhat different.

2. The species described by Walker as *Gryllus nanus* (Cat. Derm. Salt. Br. M., i, p. 214) is an immature specimen which can be ascribed with sufficient certitude to *Gryllodes sigillatus* Walk.

3. P. P. King has described in 1826 (Narrative of a survey of the intertropical and western coasts of Australia, vol. ii, p. 456) a species of *Gryllus* which is impossible to recognize without the type. This description is as follows:

Gryllus regulus, n. sp.—*G. ferrugineo-fuscus antennis filiformibus nigris, elytris obscure nebulosis, alis fusco-hyalinis, thoracis lateribus postice testaceis, corpore subtus rufo-testaceo, tibiis posticis tetaceis spinis dorsalibus rufis apicibus nigris.*

Gen. GRYLLOPSIS Chopard, 1927.

The species of this genus are very close to *Gryllulus*; they can be separated by their general shape which is more rounded; in the male, the elytra are usually shorter than the abdomen, in the female they are very short, often reduced

to lateral pads. The anterior tibiae are never perforated on the internal face but this condition is also found in micropterous forms of the genus *Gryllulus*.

One Australian species only can be ascribed to this genus.

GRYLLOPSIS ARMATIPES sp. n.

♀. Rather large, brown with transverse yellowish bands on the head and thorax; nearly glabrous, shining. Head large, globular, shining brown above with a yellow band between the ocelli and a little before the apex of frontal rostrum; the rostrum is very short, wide, a little rounded. Face short and wide, yellow; clypeo-frontal suture bent, extending a little above the inferior margin of antennal sockets. Eyes rounded, very feebly projecting; lateral ocelli large, round, anterior one small, a little before the apex of frontal rostrum. Antennae and palpi yellow; the three last joints of maxillary palpi subequal in length, slender, the last one scarcely widening at apex. Pronotum one and a third times as wide as long, a little widening in front, with anterior margin feebly concave, posterior margin straight; disk feebly convex, shining, brownish with two yellowish bands along the anterior and posterior margins; lateral lobes yellow with inferior margin a little ascending backwards, anterior angle rounded. Mesonotum rufous brown with posterior margin strongly convex. Metanotum dark brown with a narrow yellow posterior band. Abdomen rufo-testaceous with a median and two lateral longitudinal bands of brown spots; tenth tergite and anal valves yellowish; subgenital plate small, a little notched at apex. Ovipositor long, straight with depressed, slightly acute apical valves.

Legs rather long, yellowish, a little pubescent. Anterior tibiae presenting on external face a long and narrow oval tympanum. Posterior femora thick; posterior tibiae armed with strong and very close spines, the two rows of which are nearly in touch on the median line; they are 6 internal, 8 external in number; apical spurs long, yellow with brown tip; infero-internal a little shorter than the external, median and superior ones subequal in length; supero-external spur as long as the inferior, the median one almost twice as long. Posterior metatarsi long, a little compressed, armed with 5 internal, 7 external denticles; apical spurs rather short.

Elytra extending to the middle of metanotum; dorsal field triangular, shining brown with a yellow band on the edge; 7 longitudinal, somewhat irregular veins; lateral field high, yellow, presenting 5 parallel veins. Wings abortive.

Length of body 18 mm.; pronot. 4 mm.; post. fem. 12 mm.; elytra 3 mm.: ovipositor 18 mm.

Type: South Australia: Alexandria (W. Stalker, Jan., 1908), 1 ♀ (Br .M).

Gen. GRYLLODES Saussure, 1874.

The genus *Gryllodes* is restricted to one or two species of rather depressed general shape and narrow frontal rostrum. The elytra are usually rather short and truncated in the male, quite lateral in the female.

GRYLLODES SIGILLATUS (Walk.).

Gryllus sigillatus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 46.

Gryllodes sigillatus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 14.

Gryllus nanus Walker, 1869, l. cit., p. 214.

This species is widely spread in tropical countries; it is often found in houses.

North West. Australia: Broome, Kimberley Distr., Noonkanbah (Stockholm Mus.).

Gen. EUGRYLLODES Chopard, 1927.

This genus is composed of semi-desert species, light testaceous in colour, the male with very ample elytra; the females are similar to *Gryllulus*.

EUGRYLLODES DIMINUTUS (Walk.).

Gryllus diminutus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 45.

Fig. 3, 34.

This species is known only from Walker's description to which the following may be added.

Light brown, varied with yellow. Head rather large, rounded, shining brown; occiput showing 6 narrow yellow lines, the two median of which are short, the other united behind the eye; frontal rostrum rather wide but long, with a basal furrow uniting the ocelli. Face short and wide, brown; facial shield projecting, yellow; cheeks yellow. Antennae slender, yellowish brown. Maxillary palpi brownish, slender; 3 last segments subequal in length, the fifth very slightly enlarged at apex. Eyes rather small, slightly projecting; ocelli very small, the anterior one in the middle of the rostrum. Pronotum strongly transverse, with parallel sides; anterior and posterior margins nearly straight; disk almost flat, a little pubescent, brownish with light yellow impressions; lateral lobes yellowish, with straight inferior margin. Abdomen brown above, yellowish beneath; subgenital plate large, rounded. Genitalia wide and short, the superior part without median lobe (fig. 34).

Legs rather short, yellowish. Anterior tibiae a little flattened, perforated with a rather large oval tympanum on both sides; metatarsi short, compressed, spinulose beneath. Posterior femora short and rather strong; tibiae armed with 3 spines on each margin, and small variable denticles at base; these are 2 or 3 on the external margin, 1 or none on the internal margin; apical spurs rather long, pubescent, the supero-internal one a little longer than the median; metatarsi long, a little compressed, armed with 7 denticles on each margin. Elytra translucent, extending to the apex of abdomen, rounded; mirror large, almost triangular, with feebly convex margins, divided after the middle by a feebly bent vein; diagonal vein long, straight; chords feebly bent, a little diverging; 2 oblique veins; apical field almost nil; lateral field yellowish, with 4 regular, close veins, besides Sc which is furcate near the base. Wings very short.

Length of body 11·5 mm.; pronot. 2 mm.; post. fem. 7·2 mm.; elytra 7 mm.

This species differs from the others of the genus by rather important characters such as the presence of two large tympana on the anterior tibiae and the armature of the posterior tibiae which resembles that of the Gryllomorphi group with the small basal denticles.

South Australia: Mt. Lofty (J. G. O. Tepper), Kangaroo Is. (S.A.M.).

Queensland: Stapleton (S.A.M.).

Gen. CYRTOPROSOPUS nov.

κυρτός curved; πρόσωπον face).

On the armature of the legs, this genus belongs to the Gryllinae but a very wide frontal rostrum, swollen into a voluminous protuberance is suggestive of the Mogoplistinae. The elytra are short, wings very long; the elytral venation is very similar in both sexes, the male with no mirror but a very distinct anal vein.

Type: *Cyrtoprosopus stramineus* sp. n.

CYRTOPROSOPUS STRAMINEUS sp. n.

Holotype: ♂. Rather small size; yellowish, nearly glabrous on the body, the legs finely pubescent. Head a little wider than pronotum; between the eyes with a badly defined brown band, almost obliterated in the middle; forehead flattened, frontal rostrum much wider than first antennal segment rounded, smooth. Face very short, wholly covered by the big protuberance formed by the facial shield and the rostrum which are united, with a median longitudinal furrow. Eyes rounded, slightly projecting; ocelli small, the anterior one almost invisible. Palpi short, yellow; third and fourth segments of maxillary

palpi short, equal in length, fifth longer, a little enlarged and very obliquely truncated at apex. Antennae yellow. Pronotum strongly transverse, with feebly concave anterior margin, posterior margin straight; disk almost flat; lateral lobes short, with inferior margin slightly ascending backwards, anterior angle widely rounded. Abdomen brownish above, yellow beneath; supero-anal valve rounded; subgenital plate large with posterior margin rounded, a little notched in the middle.

Legs yellow; anterior one very short; femora rather thick, compressed; tibiae short, armed with 3 rather weak apical spurs, external face perforated with a large, oval tympanum; tarsus almost as long as the tibia, the first two segments provided beneath with two rows of spinules. Middle legs with the same general shape but a little longer. Posterior femora long and rather narrow; tibiae short, armed with 4 internal, 5 external spines, the first of which is very short; supero-external and infero-external spurs short, median twice as long; infero-internal spur a little shorter than the external, the two others long, equal in length, ciliated; metatarsi long, armed with 4–5 denticles on each margin above.

Elytra extending no farther than the middle of abdomen, rounded at apex, scarcely overlapping on the median line; colour light yellow, almost transparent; anal field very small, the anal vein quite distinct but nearly straight, sending an oblique vein to the median; the remainder of the dorsal field occupied by 5 veins, 2 having their origin on the anal knot, the others from the radial vein; the first one furcate, the second represents the diagonal vein, but there is no trace of a mirror; transverse veinlets scarce, forming large areolae. Wings very long.

Allotype: ♀. Quite similar to the male; veins of the dorsal field of elytra almost the same but more regularly oblique. Ovipositor rather long, straight, with apical valves lanceolate, flattened, as in the species of *Gryllulus*.

Length of body 9 mm.; length with wings 15 mm.; post. fem. 5 mm.; post. tib. 3 mm.; elytra 4 mm.; ovipositor 6 mm.

This very remarkable species is represented in the collection of the South Australian Museum by a number of individuals from different localities.

South Australia: Owieandana (Rev. A. P. Burgess), 1 ♂, North Flinders Ranges (Hale and Tindale), 1 ♀ (types); also Strzlecki Creek, Yeelanna, Murray River, Minnie Downs, Devon Downs (December), Farina (S.A.M.), Lake Mulligan (Callabonna), (S.A.M.).

Central Australia: Caravena (S.A.M.).

Gen. LOXOBLEMMUS Saussure, 1877.

The species of this genus are distinguished from those of *Gryllulus* in the shape of the head of the male, which is flattened in front, the forehead being more or less produced between the antennae. They are numerous in Indo-Malaisia; one species only is found in North Australia.

Gen. LOXOBLEMMUS PALLENS Serv.

Gryllus pallens Serville, 1839, Ins. Orth., p. 344.

Fig. 35.

The type specimen of this species exists in the collection of the Paris Museum; it is labelled "Nouvelle Hollande" without exact locality. The description may be amplified as follows:

♂. Vertex very wide, regularly but feebly arched, lined with a yellow band; occiput adorned with 6 short yellow lines. Face wide, strongly flattened, even slightly concave with median line very little projecting and feebly carinated, sides curved inwards. Anterior ocellus inserted near the superior fourth. First segment of antennae with a very short process. Elytra not extending over the fifth abdominal tergite, rounded at apex; mirror a little wider than long, forwardly angulate, backwardly rounded, not divided; diagonal vein rather long, a little curved; 1 oblique vein, first and second chords rather feebly curved, parallel; apical field very short, with a few large cells disposed on two rows; lateral field brown with 4 regularly spaced veins, Sc plain. Wings short. Genitalia widely notched at apex with very narrow lobes (fig. 35).

Length of body 17·5 mm.; post. fem. 11 mm.; elytra 8·5 mm.

This species differs from other *Loxoblemmus* in the very wide and short forehead and in the presence of only one oblique vein. The female is very similar to that of *L. detectus* Serv. with a little wider forehead.

Queensland: Kuranda (F. P. Dodd), (A.M.).

Gen. MJÖBERGELLA Chopard, 1925.

This genus was erected for a very remarkable species belonging to the group Gryllomorphites, which is characterized by the presence of small denticles before the spines of the posterior tibiae.

MJÖBERGELLA MACROCEPHALA Chopard.

Mjöbergella macrocephala Chopard, 1925, Arch. f. Zool., 18A, No. 6, p. 18, fig. 29.

This species, known from the type specimen only, is easily recognizable by its colour, its very large head and the elytral venation.

Queensland: Malanda (Stockholm Mus.).

Gen. COPHOLANDREVUS Chopard, 1925.

This genus belongs to the same division as the preceding; it is close to the Malaisian genus *Landreva* but with non-perforated anterior tibiae and obscure mirror in the male elytra.

COPHOLANDREVUS AUSTRALICUS Chopard.

Copholandrevus australicus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 15, fig. 23–28.

This species can be easily recognized by the armature of the posterior tibiae presenting on each margin 6 or 7 denticles before the spines; the elytra in the male are short, not extending farther than the metanotum, truncated at apex with a very feeble venation; in the female they are very short, separated on the median line.

Queensland: Cedar Creek, Malanda (types in the Stockholm Mus.).

Subfamily NEMOBIINAE.

This subfamily is composed of rather small species which have the posterior tibiae armed with long, movable, hairy spines. They have many common features with the Gryllinae.

KEY TO THE GENERA OF *NEMOBIINAE*.

1. Mirror of male filled with a close reticulation; female completely apterous .. .. *Dictyonemobius*
   Mirror of male usually perfectly distinct; female with elytra and wings, or at least elytra present 2
2. Posterior tibiae armed with 3 spines on each superior margin .. *Nemobius*
   Posterior tibiae with 4 spines on each margin, or on the internal margin only, in both sexes or at least in the male .. .. *Pteronemobius*

Gen. PTERONEMOBIUS Jacobson and Bianchi, 1904.

The species of this genus are typically fully alate, though a micropterous condition can prevail in certain of them. In the male the first internal spine of the posterior tibiae is very short, tuberculiform.

KEY TO THE SPECIES OF *PTERONEMOBIUS*.

1. Posterior tibiae with 4 spines on each margin in both sexes 2
   Posterior tibiae with 3 external, 4 internal spines in the male, 3–3 or 3–4 in the female 3
2. Lateral lobes of pronotum nearly black .. .. .. 1. *truncatus*
   Lateral lobes of pronotum scarcely darker than the disk .. 2. *unicolor*
3. Mirror of male reticulated, more or less confounded with the apical area (fig. 36); female with 3 internal spines on the posterior tibiae .. 3. *regulus*
   Mirror of male well separated from the apical area (fig. 37); female with 4 internal spines on the posterior tibiae .. .. .. 4. *ornaticeps*

1. PTERONEMOBIUS TRUNCATUS (Sauss.).

Nemobius truncatus Saussure, 1877, Mem. Soc. Geneve, xxv, p. 91.

Nemobius laparinthae Tepper, 1896, Horn Exp. Centr. Austr., ii, p. 378.

Pteronemobius mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 9, fig. 8–9.

The type of *truncatus*, in the Paris Museum, is in rather poor condition but it can nevertheless be identified with *laparinthae;* the first name has priority.

Small; rather uniform light brownish. Head with 4 very short, feeble light bands on the occiput; face and cheeks brown. Palpi brownish, with fourth segment very short, fifth segment large, in the shape of a long triangle. Pronotum with anterior and posterior margins straight, sides parallel; disk nearly flat, light brown with feebly darkened sides; lateral lobes dark brown, almost black. Legs yellowish brown, a little spotted with brown. Posterior femora slightly striated with brown. Anterior tibiae perforated at external face with a rather large oval tympanum.

♂. Posterior tibiae armed with 4 spines on each side, the first internal spine short, strongly swollen, curved at base, very long; inferior spurs subequal in length. Elytra extending to the apex of abdomen; mirror divided backwards by two large cells, of which the internal extends along the whole length of the internal margin; apical area a little lengthened; chords separated almost to the base. Wings short.

♀. Similar to the male. Posterior tibiae armed with 4 spines on each margin, the first internal spine very short, the last very long. Elytra somewhat shortened, light brown, with 4 rather regular veins on the dorsal field, and with very scarce transverse veinlets; the first two veins are united only a little beyond the base; lateral field concolorous with parallel veins. Wings short. Ovipositor short, nearly straight, with feebly denticulated apical valves.

Length of body ♂ 6 mm., ♀ 7 mm.; post. fem. ♂ 4 mm., ♀ 4·8 mm.; elytra ♂ 4·5 mm., ♀ 3·0–3·5 mm.; ovipositor 2·5–3·0 mm.

Queensland: Brisbane (Q.M.); Cairns Distr. (S.A.M.); Colosseum (type of *mjöbergi*); Malanda, Alice River, Chillagoe (Stockholm Mus.).

Central Australia: Finke Gorge, Reedy Hole (type and cotype ♀ of *laparinthae* (S.A.M.)).

Northern Territory: Darwin, G. F. Hill (S.A.M.).

South Australia: Wilpena Pound, Magill on and under water, Murray River, Kewell East (S.A.M.).

New South Wales: Wallacia (Hale and Tindale), (S.A.M.); Shaw's Creek Valley, Warrumbungle Range (A.M.).

2. PTERONEMOBIUS UNICOLOR Chopard.

Pteronemobius unicolor Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 9, fig. 10–11.

This species is very close to the preceding, of which it might be the macropterous condition, although differing from it in certain characters such as the more uniform colouration and the longer elytra.

Queensland: Cedar Creek (type in the Stockholm Mus.).

3. PTERONEMOBIUS REGULUS (Sauss.).

Nemobius regulus Saussure, 1877, Mem. Soc. Geneve, xxv, p. 87 (♀).

Nemobius pulex Saussure, 1877, *l. cit.*, p. 96 (♂).

Nemobius biguttatus Mjöberg, 1913, Ent. Tidskr., p. 32.

Pteronemobius parallelus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 6, fig. 3–4 (micropterous condition).

Fig. 36.

This small species is fulvous-brown with two light bands on the pronotum; head adorned with 4 light bands on the occiput; lateral lobes of pronotum very dark. Elytra of male extending to the apex of abdomen, with rather obscure mirror, diagonal vein markedly sinuate; elytra of female extending to apex

of fourth abdominal tergite, with somewhat oblique apical margin, dorsal field dark brown, shining, with 4 quite longitudinal veins. Posterior tibiae armed in the male with 3 external, 4 internal spines, of which the first is very short and tuberculiform; in the female there are 3 spines on each margin. Ovipositor nearly smooth at apex.

Length of body ♂ 3·5 mm., ♀ 4·5 mm.; post. fem. ♂ 2·8 mm., ♂ 3·2 mm.; elytra ♂ 2·1, ♀ 1·6 mm.; ovipositor 2·4 mm.

Queensland: Atherton, Malanda (types of *biguttatus*), Cape Yorke Peninsula, Bellenden Ker (types of *parallelus*); Colosseum, Mt. Tambourine (Stockholm Mus.); Brisbane, Cairns Distr., Stewart River, Rockhampton, Stradbroke Island (S.A.M.); Brisbane (Q.M.).

North West. Australia: Noonkanbah (type of *biguttatus*), (Stockholm Mus.).

Northern Territory: Without exact locality (type of *pulex* in Brunner's collection); Daly River, Groote Eylandt (S.A.M.).

New South Wales: Nepean River, Curlewis, Penrith (A.M.); Wallacia, Port Hacking (S.A.M.).

Tasmania: Galston, Dumbrell (S.A.M.).

South Australia: N.E. of S. Aust., Mt. Lofty, Adelaide, Murray River (S.A.M.); Adelaide (type of *regulus* Leyden Mus.).

4. PTERONEMOBIUS ORNATICEPS Chopard.

Pteronemobius ornaticeps Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 7, fig. 5–7.

Fig. 37.

A little larger than the preceding species; fulvous-brown; head adorned with 7 light bands. Armature of the posterior tibiae as that of *regulus* in the male, in the female 4 internal spines. Elytra of the male extending to apex of abdomen, shining brown, with transverse mirror, with two large cells. Wings aborted.

The pattern of the head is more or less visible in this species but the elytral venation in the male and the tibial armature in the female separate it from *regulus*.

Length of body ♂ 5·5 mm., ♀ 6 mm.; post. fem. 4 mm.; elytra 3·5 mm.; ovipositor 3 mm.

Queensland: Bellenden Ker (types in the Stockholm Mus.); Illingworth, Gordon Vale (Q.M.); Cairns Distr. (S.A.M.).

Northern Territory: Darwin, Groote Eylandt (S.A.M.).

North West. Australia: Fortescue River, Hammersley Range, Derby (S.A.M.).

New South Wales: Port Hacking (Tindale, March, 1927). (S.A.M.).

Moa Island, Torres Straits (J. W. Schomberg). (S.A.M.).

This species is also found in Fiji and N.E. Papua, Mount Lamington (S.A.M.).

Gen. NEMOBIUS Serville, 1839.

The species of this genus differ from *Pteronemobius* in the tibial armature, there being never more than 3 spines, even in the male; the first internal spine is not differentiated.

NEMOBIUS BIVITTATUS Walk.

Nemobius bivittatus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 59.

Nemobius australianus Mjöberg, 1913, Ent. Tidskr., p. 32; Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 6, fig. 1–2.

Nemobius femoratus Saussure, 1877, Mem. Soc. Geneve, xxv, p. 92, pl. 11 (vii), fig. 2–4.

Nemobius annulipes Saussure, *l. cit.*, p. 77.

Head black with two wide yellow bands behind the eyes and two much narrower ones near the middle. Face black; shining; cheeks rufous. Eyes big, rounded; ocelli, small, round, disposed as a triangle. Antennae blackish. Maxillary palpi with first 3 segments black, the apex of the third, the fourth and the base of the fifth fulvous; the last segment rather long, triangular, blackish in its apical half and along the superior margin. Pronotum transverse, with parallel sides, anterior and posterior margins straight; disk black with two wide fulvous bands; lateral lobes black; abdomen blackish above, grey beneath. Legs blackish; anterior and median tibiae with two yellowish rings; posterior femora with external face yellowish. Posterior tibiae on each margin armed with 3 rather long spines; yellowish at base; inferior spurs equal in length; metatarsi with proximal half yellow.

♂. Elytra extending nearly to the apex of abdomen, rounded at top, dorsal field greyish yellow, translucent; mirror rather large, oblique, almost quadrangular, somewhat widening backwards, divided by a small vein extending to the middle of the internal margin; first and second chords long, parallel, curved only towards the apical fourth chord, sometimes approaching each other in the middle; apical field practically nil; lateral field nearly black, with 3 regularly spaced veins. Wings wanting.

♀. Elytra not exceeding apex of third abdominal tergite; dorsal field almost triangular, with strongly oblique internal margin; colour yellowish brown with a small brown spot at base; with 4 parallel veins, the first and second of which are united at base; transverse veinlets very scarce, forming a few large, lengthened areolae; lateral field almost black with 4 veins. No wings. Ovipositor long, very straight, with very finely denticulated apical valves.

Length of body ♂ 6 mm., ♀ 6·5 mm.; post. fem. ♂ 4·5 mm., ♀ 5·5 mm.; elytra ♂ 3 mm., ♀ 2 mm.; ovipositor 5·5 mm.

Western Australia: Perth (type of *australianus*, in the Stockholm Mus.); Perth (Br. M.); Cape Leeuwen, Warren River (S.A.M.).

South Australia: Penola, iii, 47, entering house and attacking food (Comm. Ins. Ent.); Snuggery on pasture, iv, 1949, Waterfall Gully, Mitcham, Second Creek, Magill, Blakiston, Waranda Eyrie, Adelaide, Kangaroo Island, Karalla, Wilpena Pound, Nairne (S.A.M.).

New South Wales: Dorrigo (S.A.M.); Kosciusko 6,000 ft., Banksia (A.M.).

Victoria: Healesville (Q.M.); Melbourne (S.A.M.).

Tasmania: Hobart (S.A.M.): Bridgetown, Mrs. Lindsay (Br. M.).

Gen. DICTYONEMOBIUS nov.

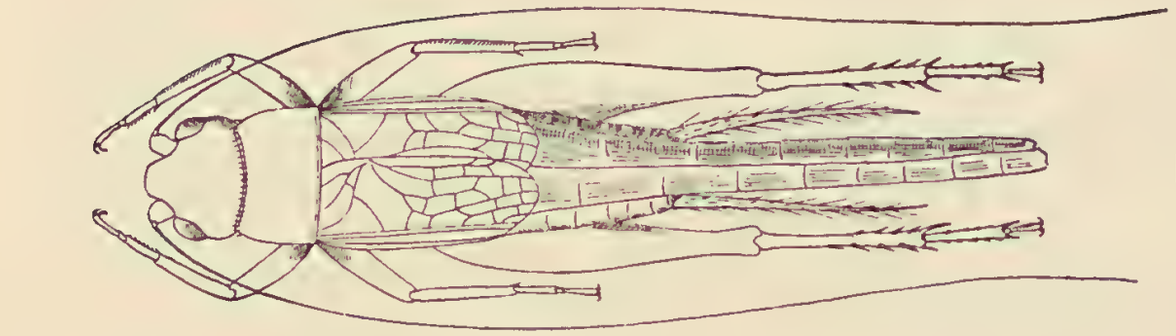
Elytra of male with ill defined mirror, this being completely filled with a close reticulation extending even between the chords. Female completely apterous. Posterior tibiae armed with 4 spines on each margin, the first internal not differentiated in the male, and 6 apical spurs. Anterior tibiae perforated at external face.

Type: *Dictyonemobius lateralis* sp. n.

DICTYONEMOBIUS LATERALIS sp. n.

Fig. 4.

♂. Rufous brown with a black lateral band extending from the head to the apex of elytra. Head as wide as pronotum, with 4 brown lines on the occiput; vertex bearing 4 rows of long bristles; frontal rostrum wide, rounded. Face short, with a λ-shaped mark on the facial shield; cheeks black. Eyes rounded, rather big; ocelli small, the anterior one almost at the apex of the rostrum. Antennae yellowish, ciliated. Palpi brownish; fourth segment of maxillary palpi much shorter than the third, fifth in the shape of a very long triangle. Pronotum with feebly convex sides, straight anterior and posterior margins, anterior margin bordered with long bristles; disk almost flat with the



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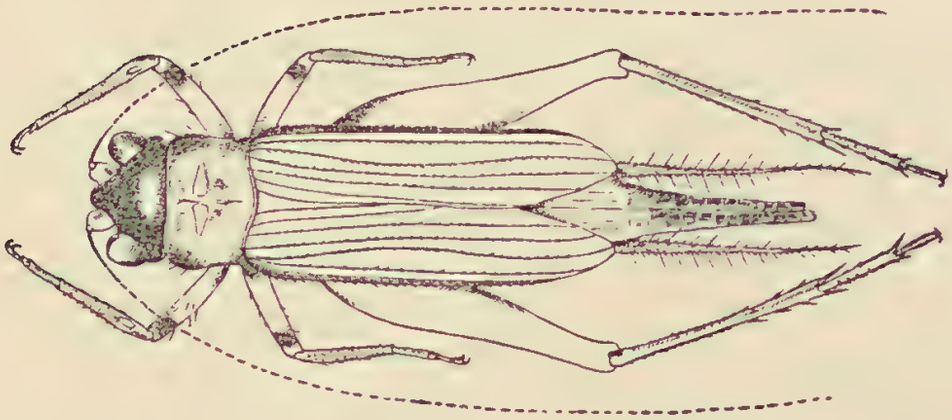

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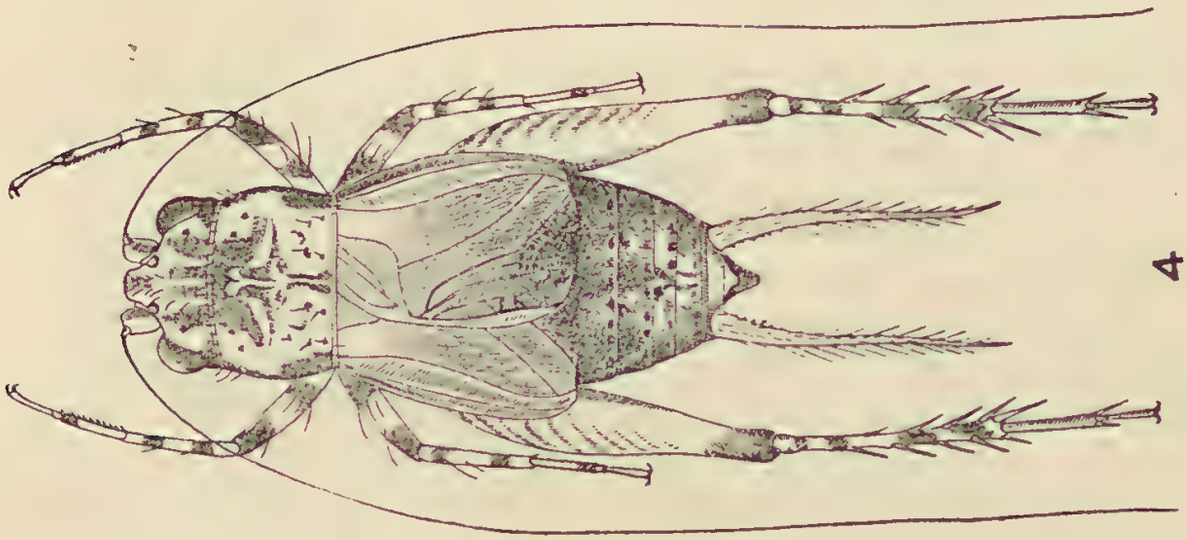

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Fig. 4. *Dictyonemobius lateralis* sp. n. ♂. Fig. 5. *Pentacentrus australianus* sp. n. ♂.
Fig. 6. *Cyrtoprosopus straminicus* sp. n. ♂.

median line somewhat deepened, yellowish rufous with two brown spots near the anterior margin and small spots of the same colour, each bearing a bristle, disposed in 5 rows of 4 spots; lateral lobes completely black, with weakly sinuated inferior margin, rounded posterior angle. Abdomen brown, pubescent; posterior margin of each tergite rufous with a row of about ten small brown spots; supero-anal valve rounded; subgenital plate compressed. Legs yellowish rufous, mottled with brown. Anterior and median femora with 2 brown rings, one at base the other at apex; tibiae also with two brown rings, the anterior perforated with a large, oval tympanum; apical spurs long and slender; metatarsi long, yellowish, a little darkened at apex. Posterior femora short and thick, striated with brown at external face; tibiae with two brown rings, one at base the other near apex; 4 long slender spines on each margin, the first internal spine is small but not swollen; inferior spurs equal in length, the two large internal ones very long, ciliated; supero-external spur very similar to the last spine, the median spur almost twice as long; metatarsus long and slender, armed with two apical spurs of which the internal is much the longer. Elytra extending to middle of fifth abdominal tergite, almost truncated at apex; disk rather dark brown with strong, yellow veins; mirror quite indistinct, lost in a net of small, rather irregular cells; diagonal vein long, almost straight; chords almost straight, parallel, united towards their extremity by that same reticulation which fills the mirror; oblique vein feebly sinuated; lateral field black with 4 regularly spaced veins. Wings very short.

♀. Apterous, similar to the male in shape and colouration. Ovipositor rather short and thick, with apical valves scarcely wider than the stem, with feebly concave, very finely denticulated superior margin, apex acute. Subgenital plate wide, angularly notched.

Length of body 7·5 mm.; post. fem. 4·6 mm.; elytra ♂ 3 mm.; ovipositor 4·2 mm.

Types: Norfolk Island, A. M. Lea, 1 ♂, 1 ♀ (S.A.M.).

Lord Howe Island, 2 immature specimens almost certainly belonging to the same species.

DICTYONEMOBIUS (?) HETEROPUS (Walk).

Nemobius heteropus Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 60.

This species, described from Australia, without exact locality, may perhaps be ascribed to this genus. It would differ from the preceding in the whitish maxillary palpi. The original description is as follows:

"*Female.* Black, tomentose, rather stout. Head and prothorax setose. Head short, as broad as the prothorax. Eyes transversely elongated, rather large, slightly prominent. Maxillary palpi whitish; third segment slightly

securiform, much longer than the second. Antennae slender. Oviduct as long as the abdomen. Legs rather stout; hind femora testaceous at the base and beneath; hind tibiae with four long slender spines on each side, these spines testaceous towards the base. Wings entirely wanting. Length of body 3½ lines."

Note. *Nemobius australis* Walker (*loc. cit.*, p. 59) of which I have seen the type, is not a *Nemobius* but a larva of a species of Eneopterinae.

FAMILY MYRMECOPHILIDAE.

The small Grylloids of this family are very remarkable both in shape and in their habits as they live with ants of numerous species. The family comprises two genera only of which one is represented in Australia.

Gen. MYRMECOPHILA Latreille, 1829.

The characters are those of the family.

KEY TO THE SPECIES OF *MYRMECOPHILA*.

1. Posterior tibiae armed with 2 internal spines .. .. .. 1. *australis*
   Posterior tibiae armed with 3 or 4 internal spines 2
2. Posterior tibiae armed with 3 internal spines of which the second is very short .. .. 2. *testacea*
   Posterior tibiae armed with 4 internal spines, the first and third of which are short .. .. 3. *mjöbergi*

1. MYRMECOPHILA AUSTRALIS Tepper.

Myrmecophila australis Tepper, 1896, Trans. R. Soc. S. Austr., xx, p. 149; Chopard, 1925, p. 19, fig. 31–32.

The male of this species is pale brownish ochraceous, with meso-metanotum and abdominal segments with dark posterior borders; base of antennae hirsute. Posterior tibiae with 1 external, 3 internal spines; hind tarsi longer than tibia, very slender, metatarsus with 3 minute spines and a longer terminal spur. The female is a little larger and darker; the ovipositor is of the same type as *M. acervorum*, the apical valves being truncated and feebly notched at apex.

Length of body 3 mm.; post. fem. 2 mm.; ovipositor 2 mm.

New South Wales: Sydney (A. M. Lea), (A.M.).

Queensland: Herberton (Stockholm Mus.).

South Australia: Hillsides near Adelaide, under stones with ants (type in S.A.M.).

2. MYRMECOPHILA TESTACEA Chopard.

Myrmecophila testacea Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 20, fig. 33–37.

A little larger than the preceding species, differing in its very pale colouration and the armature of posterior tibiae which are provided with 3 spines on the internal margin, of which the second is very short.

Length of body 4 mm.; post. fem. 2·5 mm.; ovipositor 2 mm.

Queensland: Atherton, Herberton (types in the Stockholm Mus.).

3. MYRMECOPHILA MJÖBERGI Chopard.

Myrmecophila mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 21, fig. 38.

Quite similar to the preceding species, from which it differs only in the armature of the posterior tibiae.

Queensland: Evelyne (type in the Stockholm Mus.).

FAMILY MOGOPLISTIDAE.

This group is also composed of small species with posterior tibiae deprived of spines, their superior margins being only serrulated. Their body is often covered with scales which tend to fall very easily; the elytra are short or absent in the males, always wanting in the females.

KEY TO THE GENERA OF *MOGOPLISTIDAE*.

Anterior tibiae not perforated; both sexes apterous .. .. *Arachnocephalus*

Anterior tibiae bearing an internal small tympanum; males provided with elytra .. .. *Ornebius*

Gen. ORNEBIUS Guerin, 1844.

Small species with rather slender shape. Head small, flattened, face forming a strong protuberance. Pronotum produced backwards above the metanotum, with convex posterior margin; elytra short, partly covered by the pronotum. Female apterous.

This species of this genus are numerous in all tropical countries.

KEY TO THE SPECIES OF *ORNEBIUS*.

MALES.

1. Process of anal valves furcate; tenth abdominal tergite notched 1. *mjöbergi*

Process of anal valves plain; tenth abdominal tergite truncated .. 2

2. Elytra blackish with a large milky spot in the middle .. .. 11. *hackeri*
   Elytra yellowish or light brownish with more or less darkened posterior margin 3
3. Posterior femora adorned with a large brown spot; size rather large (length 10 mm.) .. .. 14. *fascipes*
   Posterior femora unicolorous (length 6–8 mm.) 4
4. Process of the anal valves black 5
   Process of the anal valves rufous or yellowish 7
5. Process of the anal valves flattened .. .. 7. *brevithorax*
   Process of the anal valves cylindrical 6
6. Pronotum feebly enlarged backwards; mirror not divided; size very small (5·5 mm.), slender, pale testaceous .. .. .. 4. *pallidus*
   Pronotum distinctly enlarged backwards; mirror divided; a little larger (6·5 mm.), rufo-testaceous with brownish scales .. 5. *australicus*
7. Fifth segment of maxillary palpi much longer than wide (fig. 41 and 42) .. .. 2. *nigromaculatus*
   Fifth segment of maxillary palpi almost as wide as long (fig. 42) .. 8
8. Process of the anal valves thin at top (fig. 38 and 43) .. 6. *curtipalpis*
   Process of the anal valves a little swollen at top (fig. 39) .. 3. *howensis*

FEMALES.

1. Apical valves of ovipositor smooth 2
   Apical valves of ovipositor more or less finely denticulated beneath (fig. 45) 8
2. Last segment of maxillary palpi much longer than wide 3
   Last segment of maxillary palpi almost as wide as long 6
3. Large size (11·5 mm.); head with a brown band behind the eyes .. 9. *laevicauda*
   Smaller species (7·5 mm.–10 mm.); head without brown band behind the eyes 4
4. Frontal rostrum slightly wider than the first segment of antennae .. 2. *nigromaculatus*
   Frontal rostrum almost twice as wide as the first segment of antennae 5
5. Ovipositor longer (4·5 mm.) .. .. 5. *australicus*
   Ovipositor shorter (3 mm.) .. .. 7. *brevithorax*
6. Ovipositor longer (4·5 mm.) .. .. 4. *pallidus*
   Ovipositor shorter (3 mm.) 7

7. Pronotum longer than wide .. .. 6. *curtipalpis*
   Pronotum almost square .. .. 3. *howensis*
8. Fifth segment of maxillary palpi obliquely truncated, subsecuriform; legs fasciated with brown .. .. 14. *fascipes*
   Fifth segment of maxillary palpi triangular 9
9. Size very small (5 mm.) .. .. 13. *parvus*
   Size larger (7·5 mm.) 10
10. Frontal rostrum very wide; general shape narrow .. .. 12. *latifrons*
    Frontal rostrum a little wider than the first antennal segment; general shape not so narrow 11
11. Pronotum almost square .. .. 10. *parvithorax*
    Pronotum distinctly longer than wide 12
12. Last segment of maxillary palpi as wide as long .. .. 11. *hackeri*
    Last segment of maxillary palpi longer than wide .. 8. *denticauda*

1. ORNEBIUS MJÖBERGI (Chop.).

Hoplosphyrum mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 21, fig. 39, 41, 42.

This species is very distinct in its varied blackish and yellow colouration, in the frontal rostrum not being wider than the first antennal segment, blackish, shining, non divided, and in the very peculiar shape of the anal valves.

Queensland: Cedar Creek (type in the Stockholm Mus.).

2. ORNEBIUS NIGROMACULATUS (Chop.)

Liphoplus nigromaculatus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 22, fig. 40, 43–46.

Fig. 41, 42.

The male of this species is rufous with elytra completely freed from pronotum, testaceous, a little whitish and spotted with blackish at base and near the apical margin. Pronotum rather strongly narrowing in front. Process of the anal valves erect (fig. 41), long, very slender, feebly flattened on internal face. Female rufous with pronotum almost as wide as long, slightly narrowing in front; ovipositor rather short, straight, with apical valves smooth, acute at apex.

Length of body ♂ 8·5 mm., ♀ 8–10 mm.; ovipositor 4 mm.

Queensland: Cairns Distr., Mt. Tambourine (S.A.M.); Mt. Tambourine (A.M.); Brookfield (Q.M.); Mt. Tambourine, Yarranbah, Bellenden Ker (Stockholm M.).

dunkensis, ssp. nov.—Dunk Island (H. Hacker, Aug., 1927), 1 ♂, 1 ♀ (Q.M.).

Very similar to the type but process of the anal valves of the male not at all flattened, very slender, almost acute or feebly rounded at apex.

3. ORNEBIUS HOWENSIS sp. n.

Fig. 39.

♂. Extremely close to the preceding, but with pronotum less narrowing in front, elytra with three blackish spots along the posterior margin instead of a complete band, process of the anal valves rounded and somewhat swollen at apex. In both sexes the last segment of maxillary palpi is shorter than in the preceding species.

Length of body ♂ ♀ 7 mm.; pronot. ♂ 2·8 mm., ♀ 2·2 mm.; elytra ♂ 2·2 mm.; ovipositor 4 mm.

Types: Lord Howe Island (A. M. Lea), 1 ♂, 1 ♀ (S.A.M.).

4. ORNEBIUS PALLIDUS (Chop.).

Liphoplus pallidus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 23, fig. 47, 56.
Liphoplus griseus Chopard, 1925, *l. cit.*, p. 25, fig. 51.

Male smaller and more slender than in the preceding species; pale testaceous with brown scales on the legs and abdomen. Elytra covered by pronotum to the anterior angle of the mirror which is large, undivided; apical margin of the elytra darkened. Process of the anal valves erect, cylindrical, black. Pronotum feebly narrowing in front. Last segment of maxillary palpi short. In the female, pronotum a little longer than wide, ovipositor rather long, with smooth apical valves.

Length of body ♂ 5·5 mm., ♀ 6·5 mm.; pronot. ♂ 2 mm., ♀ 2 mm.; elytra ♂ 1·5 mm.; ovipositor 4·5 mm.

Queensland: Herberton (type); Atherton, Yarrabah (Stockholm Mus.); Bathurst Head (S.A.M.); Cape Yorke (type of *griseus*, Stockholm Mus.).

New South Wales: (*griseus*), Upper Williams River (S.A.M.).

5. ORNEBIUS AUSTRALICUS (Chop.).

Liphoplus australicus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 26, fig. 52, 53, 57.

The male is close to the preceding species but with pronotum narrowing more in front, elytral mirror divided by a sinuate vein. Process of the anal

valves erect, blackish, subacute at apex. Female rufous, with pronotum a little longer than wide; ovipositor short with apical valves scarcely wider than the stem, smooth, acute.

Length of body ♂ 6·5 mm., ♀ 6·5 mm.; elytra ♂ 2·5 mm.; ovipositor 4·5 mm.

Queensland: Yarrabah (types in the Stockholm Mus.); Bathurst Head (S.A.M.).

6. ORNEBIUS CURTIPALPIS sp. n.

Fig. 38, 43.

Very similar to the preceding, but larger. Frontal rostrum a little wider than the first antennal segment, yellowish. Maxillary palpi yellowish, spotted with brown at external face, with short and wide fifth segment. Antennae yellow with a few weak brown rings.

♂. Pronotum rufous with whitish scales, rather strongly narrowing in front, posterior margin convex, covered with white scales, lateral lobes concolorous. Abdomen rufous brown with white and grey scales; tenth tergite with truncated posterior margin; process of the anal valves erect, feebly curved, rather slender with apex slightly narrowing but rounded (fig. 38). Legs yellowish, tibiae vaguely ringed with grey. Elytra well freed from pronotum, with large mirror, posterior margin irregularly darkened, the dark part forming three vague spots; lateral field rufous brown.

♀. Pronotum a little longer than wide, with feebly convex posterior margin. Ovipositor rather short with apical valves feebly enlarged, lanceolate, with smooth margins.

Length of body ♂ ♀ 7·5 mm.; pronot. ♂ 3·1 mm., ♀ 2 mm.; post. fem. 4·5 mm.; elytra ♂ 3 mm.; ovipositor 3·8 mm.

This species differs from the preceding in the shorter apical segment of the maxillary palpi. It is close to *pallidus*; the male differs in the yellowish process of the anal valves, the female is smaller with relatively longer ovipositor.

Types: New South Wales: Dorrigo (W. Heron), 1 ♂, 1 ♀ (S.A.M.), Sydney, Cooper Park (K. C. McKeown, Feb., 1932), (A.M.).

7. ORNEBIUS BREVITHORAX sp. n.

Fig. 40.

♂. Small; testaceous covered with grey scales. Head a little flattened; frontal rostrum a little wider than the first antennal segment, furrowed. Face yellowish. Antennae and palpi yellowish; fourth segment of maxillary palpi

short, wide, fifth as long as the third, triangular in shape. Pronotum feebly narrowing in front, remarkably short, with anterior margin feebly concave, angles rounded, posterior margin widely rounded but weakly convex. Abdomen blackish, covered with grey scales; process of the anal valves blackish, a little obliquely erected, compressed in the shape of a small, rather wide lamella, subacute at apex (fig. 40). Cerci very long, yellowish. Legs short, of the same colour as the body. Anterior tibiae perforated with a small round tympanum; anterior and median tarsi very short. Posterior tibiae a little curved; metatarsi armed with 5–6 strong denticles above on each margin. Elytra feebly whitish with rufous brown posterior margin; mirror large with wholly rounded anterior margin.

♀. Anterior part of the body yellowish testaceous; posterior half of the abdomen blackish brown. Head as in the male. Pronotum a little longer than wide, feebly narrowing in front, with straight anterior and posterior margins, rounded anterior angles. Cerci long, pale yellowish. Ovipositor rather short and thick; apical valves feebly enlarged, lanceolate with straight superior margin, smooth, the superior ones bearing 4 long bristles near the apex of the inferior margin.

Length of body ♂ 7 mm., ♀ 7·5 mm.; pronot. ♂ 2·2 mm., ♀ 1·8 mm., post. fem. ♂ 4 mm., ♀ 4·2 mm.; elytra ♂ 1·8 mm.; ovipositor 3 mm.

The male of this species is remarkable in its short pronotum and also in the elytra which are not much longer than the pronotum itself; the female is close to that of *australicus* but with a very short ovipositor.

Torres Straits: Murray Is., Yorke Is., Coconut Is., Darnley Is., Thursday Is. (S.A.M.).

Type: Torres Straits, Murray Island (A. M. Lea), 1 ♂ (Q.M.); allotype

8. ORNEBIUS DENTICAUDA sp. n.

Fig. 45.

♀. Very close to *nigromaculatus*; rufous with apex of abdomen a little darker; legs yellowish, anterior and middle tibiae feebly annulated with brown. Frontal rostrum brown, a little wider than the first antennal segment. Antennae yellow with a few small brown rings; palpi feebly mottled with brown, last segment of maxillary palpi longer than wide. Ovipositor rather long, straight, the margin of the inferior apical valves with 6 small denticulations (fig. 45).

Length of body 7 mm.; pronot. 2·1 mm.; post. fem. 5·4 mm.; ovipositor 4·6 mm.

A male from the same locality might belong to this species; unfortunately the abdominal extremity is damaged with partly destroyed processes of the anal valves. As a whole it is very close to, if not identical with *nigromaculatus*.

Type: Queensland: Brookfield (H. Hacker, 16, iii, 1927), 1 ♀ (Q.M.).

9. ORNEBIUS LAEVICAUDA sp. n.

♀. Large for the genus; rufo-testaceous with grey and white scales. Head a little flattened with frontal rostrum a little wider than first antennal segment, furrowed; face yellowish; cheeks covered with white scales with a brown band behind the eye. Antennae yellowish with pale brown rings. Maxillary palpi with segments 3–5 spotted with brown on the external face, fifth segment large, triangular, longer than wide. Pronotum a little longer than wide, feebly narrowing in front; lateral lobes with a brown band in the prolongation of the postocular band; beneath this brown band there is a whitish space following the white cheeks. Abdomen long and narrow; tenth tergite with posterior angles projecting but rounded, straight posterior margin. Ovipositor straight, rather long, with feebly enlarged apical valves, the superior ones narrow, with rounded basal angle, the inferior ones smooth. Legs moderately long, yellowish with a few spots of brown scales.

Length of body 11·5 mm.; pronot. 2·5 mm.; post. fem. 6·8 mm.; ovipositor 6 mm.

Type: New South Wales: Ulong, East Dorrigo (W. Heron, iv, 1933), 1 ♀ (A.M.).

This species is characterized by its large size and smooth ovipositor.

10. ORNEBIUS PARVITHORAX (Chop.).

Liphoplus parvithorax Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 24, fig. 48–49.

Male unknown. Female rather large, rufous brown, covered with grey scales; pronotum nearly square. Ovipositor rather short, a little curved downwards, with apical valves acute, the superior ones very finely denticulated, the inferior ones with 7 stronger denticles.

Length of body 10 mm.; ovipositor 6 mm.

Queensland: Christmas Creek (type in the Stockholm Mus.).

11. ORNEBIUS HACKERI sp. n.

This species is a little larger than the medium size. Head with frontal rostrum of the same width as the first antennal segment, shining dark brown, very finely furrowed. Maxillary palpi yellowish with a brown line on the external face of each segment; fourth segment very short, fifth equally short and wide. Antennae yellowish with the first two segments brown and a number of distal brown rings.

♂. Pronotum rufous, feebly narrowing in front with posterior margin convex, covered with white scales; lateral lobes concolorous. Abdomen brownish with grey scales; tenth tergite dark brown, very wide, with straight posterior margin, rounded angles. Process of the anal valves testaceous, flattened with narrow but not acute apex. Cerci yellowish. Femora yellowish with a few brown scales; tibiae brown. Elytra blackish brown with a large whitish spot in the middle; mirror as long as wide with posterior margin very feebly convex, very obtuse anterior angle.

♀. Head and legs as in male. Pronotum a little longer than wide, feebly narrowing in front, rufo-testaceous with grey scales. Abdomen of the same colour as the pronotum; tenth tergite darker, transverse with posterior margin feebly convex. Ovipositor rather long, straight, with weakly enlarged, lanceolate apical valves; their superior margin smooth, the inferior valves with 6 rounded, feebly projecting teeth.

Length of body 8·5 mm.; pronotum ♂ 3 mm., ♀ 2·1 mm.; post fem. ♂ 5·2 mm., ♀ 5·6 mm.; elytra ♂ 2·4 mm.; ovipositor 6·5 mm.

Types: Queensland: Brisbane (H. Hacker, 24, v, 1925), 1 ♂, 1 ♀ (Q.M.).

12. ORNEBIUS LATIFRONS sp. n.

♀. Size medium; rufous brown. Head with very wide frontal rostrum, nearly twice as wide as first antennal segment, finely furrowed, rounded at top. Face short and wide, adorned with a brown band on the mandibles and the cheeks, and two crescent-shaped spots on the facial shield. Antennae yellow with the two first segments brown and a few distal brown rings. Palpi short; fourth segment of maxillary palpi very short, enlarged at top, fifth segment as long as third, in the shape of a wide triangle, somewhat obliquely truncated at apex; the first 4 segments adorned with an external brown band, the fifth wholly brown. Pronotum a little shorter than wide, very feebly narrowing in front. Ovipositor short, feebly curved, with apical valves lanceolate, their inferior margin with a dozen very small teeth. Tibiae annulated with brown; posterior metatarsi yellow with brown top.

Length of body 7·5 mm.; post. fem. 4 mm.; ovipositor 3·5 mm.

Type: South Australia: Waterfall Gully (Tepper, 23, vi, 1884), 1 ♀ (S.A.M.).

This species, although close to the preceding, is distinguished by the very wide frontal rostrum and by the ovipositor with apical valves finely denticulated beneath and superior margin a little convex.

A second example from Third Creek, S. Aust., J. Jennings, 29, viii, 1900 (S.A.M.).

13. ORNEBIUS PARVUS sp. n.

♀. Very small; rufo-testaceous, covered with brown and white scales. Frontal rostrum long, a little wider than the first antennal segment. Antennae yellow with a few distal small brown rings. Maxillary palpi with fourth segment a little shorter than third, fifth rather long, triangular in shape. Pronotum almost square, very weakly narrowing in front, with straight margins, angles rounded. Abdomen narrow; tenth tergite narrowing backwards, with feebly concave posterior margin. Ovipositor rather short, with lanceolate, smooth apical valves; the basal angle is well marked and both margins are provided with stiff bristles. Anterior and medium tibiae feebly ringed with brown.

Length of body, 5 mm.; post. fem. 3 mm.; ovipositor 2·5 mm.

Type: Melville Island (W. D. Dodd), 1 ♀ (S.A.M.).

This is the smallest of the Australian species of *Ornebius*.

14. ORNEBIUS FASCIPES sp. n.

Fig. 44.

♂. Rather large size; rufous with darker head and apex of abdomen; legs fasciated with brown. Head very dark brown; frontal rostrum as wide as first antennal segment, furrowed; facial protuberance projecting. Antennae yellowish. Palpi yellowish brown; fourth segment very short, fifth large, subsecuriform, obliquely truncated at apex (fig. 44). Pronotum very feebly narrowing anteriorly, with posterior margin slightly convex; disk rufous, provided with silvery scales forming a narrow white band along the anterior and posterior margins; lateral lobes wholly covered with white scales. Abdomen covered above with whitish scales to the seventh tergite, the three last tergites covered with bright black scales; beneath the basal scales are rather yellowish. Subgenital plate wide, triangular with posterior margin feebly convex, with long

bristles; superior anal valves transverse, with straight apical margin. Process of the inferior anal valves cylindrical, obliquely erect and very weakly curved at apex which is blunt. Anterior and middle legs rather short; femora covered with silver scales with near the apex a large brown band; tibiae with a similar but less distinct band at base, anterior tibiae perforated on internal face with a rather large round tympanum. Posterior femora rather thick, darkened at apex and with a large brown oblique spot above and on the superior part of the external face; tibiae short, strongly denticulated; metatarsi compressed, rather stout, bearing on each superior margin 5–6 denticles, the apical spurs short and strong. Elytra covered by pronotum nearly to the angle of the mirror, yellowish with very dark apical band; mirror very large, as long as wide, with feebly arched posterior margin, anterior angle rounded; lateral field yellow.

♀. Head and legs as in the male. Pronotum a little longer than wide, with anterior and posterior margins straight, sides a little convex; disk rufous with white scales chiefly numerous along the posterior margin. Abdomen blackish with rufous base; subgenital plate black, rather strongly notched at apex. Cerci long, yellowish at base, vaguely annulated with white and brown towards their apex. Ovipositor rather long, straight with apical valves ovato-lanceolate, their inferior margin very finely denticulated, pubescent.

Length of body ♂ 10 mm.; ♀ 10·5 mm.; pronot. ♂ 3·5 mm., ♀ 2·8 mm.; post. fem. ♂ 5·3 mm., ♀ 5·5 mm.; ovipositor 6 mm.

A rather large species, well characterized by its colouration and by the shape of the maxillary palpi.

Types: Queensland: Bathurst Head (Hale and Tindale, i, 1927), 1 ♂, 1 ♀ (S.A.M.).

Gen. ARACHNOCEPHALUS Costa, 1855.

The species of this genus differ from the preceding in being completely apterous in both sexes and in having the anterior tibiae not perforated by a tympanum.

The genus comprises a fairly large number of species in the Malay and Papuan regions; only one occurs in Australia.

ARACHNOCEPHALUS AUSTRALICUS Chopard.

Arachnocephalus australicus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 27, fig. 54, 55, 57.

West. Australia: Broome (types in the Stockholm Mus.).

FAMILY PENTACENTRIDAE.

This family comprises a small number of species which vary considerably in their general habitus but have in common a distinctive insertion of the antennae, i.e. very low on the face, beneath the middle.

KEY TO THE GENERA OF *PENTACENTRIDAE*.

1. General shape long and rather slender; male without distinct mirror
Pentacentrus

General shape wide; elytra of male very ample with distinct mirror
Eurygryllodes

Gen. PENTACENTRUS Saussure, 1878.

The small species of this genus are very well characterized by their narrow general shape with long elytra; the venation is almost similar in both sexes. The species of *Pentacentrus* are numerous in the Malay Archipelago and in Papua. One species only is known from South Australia.

PENTACENTRUS AUSTRALIANUS sp. n.

Fig. 5.

Uniformly brown; finely pubescent. Head dark brown, very finely punctated; frontal rostrum with parallel sides, a little narrower than first antennal segment. Face short, brown. Ocelli very small, particularly the anterior one. Antennae and palpi yellowish brown; maxillary palpi short, with fourth segment a little shorter than third, fifth triangular, wide, with almost equal sides. Pronotum lighter than head, of a somewhat rufous brown; feebly narrowing in front, anterior margin straight, posterior strongly sinuated; lateral lobes a little darker than the disk, with rounded angles. Abdomen brown above, yellowish beneath; subgenital plate small, narrowing towards apex which is slightly truncated. Ovipositor rather short, feebly curved upwards, with narrow, lengthened apical valves, their apex a little rounded, their external faces finely granulated. Legs yellowish, pubescent. Anterior and middle femora with a weak apical brown tinge; anterior tibiae perforated with a large internal tympanum. Posterior femora rather thick, uniformly yellowish brown; tibiae armed with 3 spines on each margin; metatarsi long, compressed, denticulated on both superior margins. Elytra light brown, with a feeble lighter humeral band, finely pubescent; dorsal field with 4 longitudinal, almost parallel veins, the first only slightly sinuate; transverse veinlets scarce and feebly

visible, lateral field with 4 longitudinal veins, the third of which is abbreviated. Wings much longer than the elytra, darkened at apex.

Length of body 7·5 mm.; length with wings 11 mm.; post. fem. 4·9 mm.; elytra 5·7 mm.; ovipositor 3 mm.

Type: South Australia: Burnside (Handschin, May, 1931), 1 ♀ (S.A.M.).

This species is very close to *Pentacentrus unicolor* Chop., from Java; it differs from it in the wider fifth segment of maxillary palpi, in the more pubescent elytra, with more regular veins and in the shorter, stouter ovipositor, the apical valves of which are a little rounded.

Gen. EURYGRYLLODES nov.

Head with wide frontal rostrum; forehead long, sloping; face short, with facial shield convex. Antennae inserted beneath the middle of the face. Pronotum strongly transverse. Legs short; anterior tibiae perforated either side; posterior tibiae armed with a few denticles at base and 3 long and slender spines on each margin; 6 apical spurs, the inferior spurs very small, externo-median longer than the superior; the two large internal spurs very long. Elytra of male wide, rounded, with quite tansverse apical mirror, divided behind the middle; 3 oblique veins; anal field with very weak veins.

Type: *Eurygryllodes latipennis* sp. n.

EURYGRYLLODES LATIPENNIS sp. n.

Fig. 7.

Size medium; yellowish; general habitus somewhat suggestive a *Eugryllodes*. Head wider than pronotum in front; vertex strongly sloping, ending in a short truncated rostrum, about twice as wide as the first antennal segment. Face very short and wide; clypeus strongly swollen, with convex superior margin, extending nearly to the top of the face, so that the facial shield is practically formed by it. Antennae and palpi yellow; maxillary palpi lacking the last segment; the third and fourth equal in length. Eyes small, little prominent, rounded; ocelli very small. Pronotum markedly wide and short, narrowing a little in front, with anterior margin feebly notched in the middle, posterior margin straight; disk feebly convex, a little furrowed in the middle; lateral lobes rather high, with sinuated inferior margin, rounded anterior angle. Abdomen yellowish; supra-anal valve triangular, rounded at apex; subgenital plate narrowing at apex. Genitalia composed of a superior bridge, ending on each side in a rather long, rounded process; near the middle there are two small rounded prolongations; the inferior parts are a little longer,

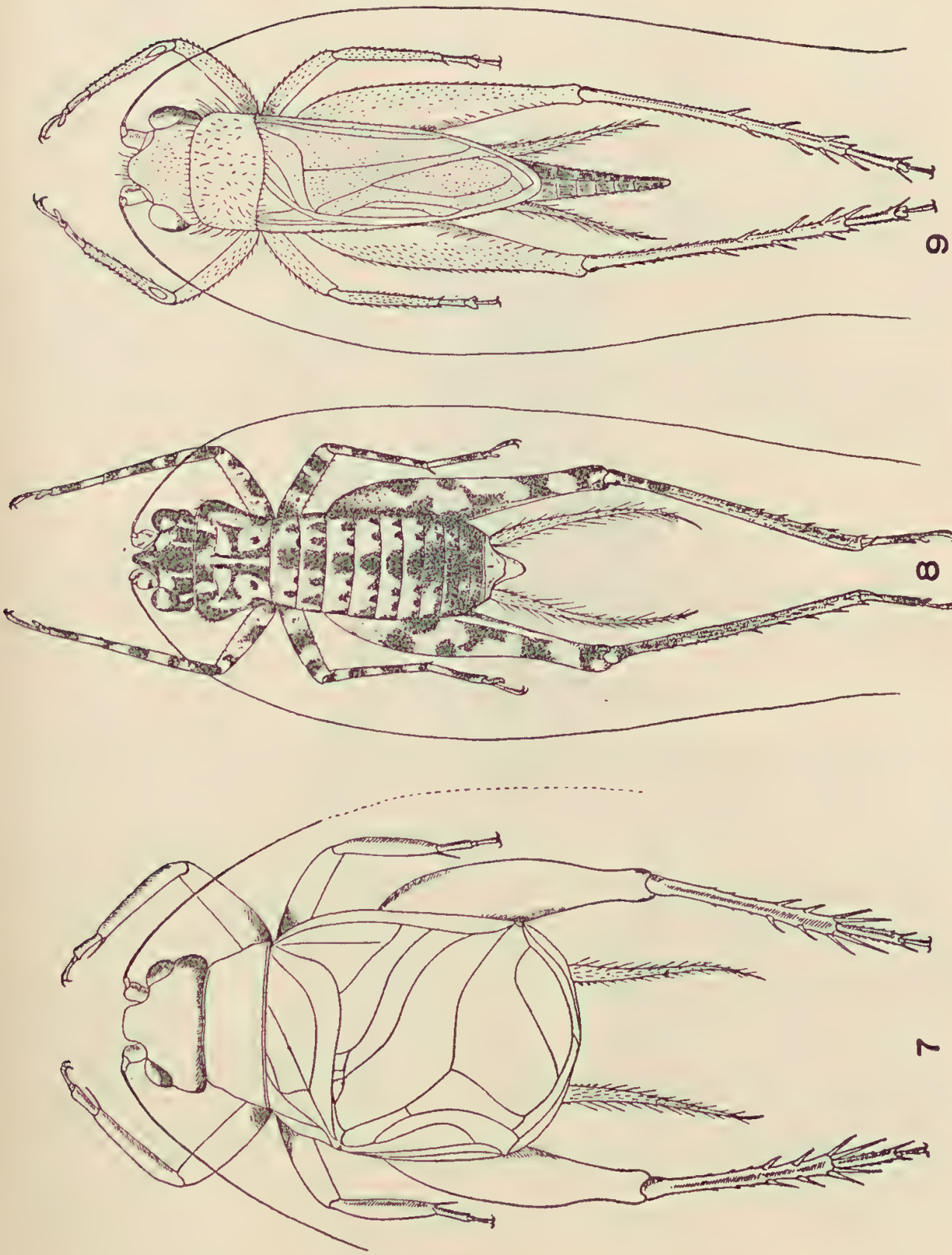


Fig. 7. *Eugryllodes latipennis* sp. n. ♀. Fig. 8. *Endotaria aptera* sp. n. ♂. Fig. 9. *Cyrtoxiphloides leai* sp. n. ♂.

sinuated, contiguous on the median line. Elytra very wide, a little longer than the abdomen, rounded at apex; mirror nearly twice as wide as long, weakly angulated in front, divided behind the middle by a sinuate vein; diagonal vein long, a little curved very close to the first chord; the two first chords long, parallel, curved, the third one straight; apical field practically nil; lateral field with 4 parallel veins, Sc simple. Wings very short.

Length of body 8 mm.; length with elytra 9·5 mm.; post. fem. 5·6 mm.; post. tib. 3·8 mm.; elytra 6·5 mm.

Type: Killalpaninna, 100 miles E. of Lake Eyre (H. G. Hillin, 1905), 1 ♂ (Br. M.).

This very peculiar species could be taken for one of the Gryllidae were it not for the low insertion of the antennae. It is quite different from other forms of Pentacentridae, even to the shape of the genitalia which are also rather like those of Gryllidae.

FAMILY CACOPLISTIDAE.

This family includes one genus only but this genus is one of the most extraordinary types of Grylloids.

Gen. CACOPLISTES Brunner, 1873.

Head very small with narrow, sloping frontal rostrum. Pronotum square, hollowed and embossed above, with strongly elevated sides in the shape of a crest. Tibiae quadrangular, the anterior ones perforated with a small internal tympanum. Posterior femora very slender, not at all swollen at base; tibiae serrulated, without spines, armed with 6 apical spurs. Elytra of male with mirror divided by two veins, numerous oblique veins; mediastinal vein bearing many branches. Elytra of female corneous, convex, rugose. Ovipositor long, slender with acute apical valves.

The species of *Cacoplistes* are rather large Grylloids which have a certain resemblance with the Phalangopsidae; but their small head, their very peculiar pronotum and their slender posterior legs gives them a quite different appearance to all the other Grylloids.

One species of this interesting genus is known from India and one or two from Australia.

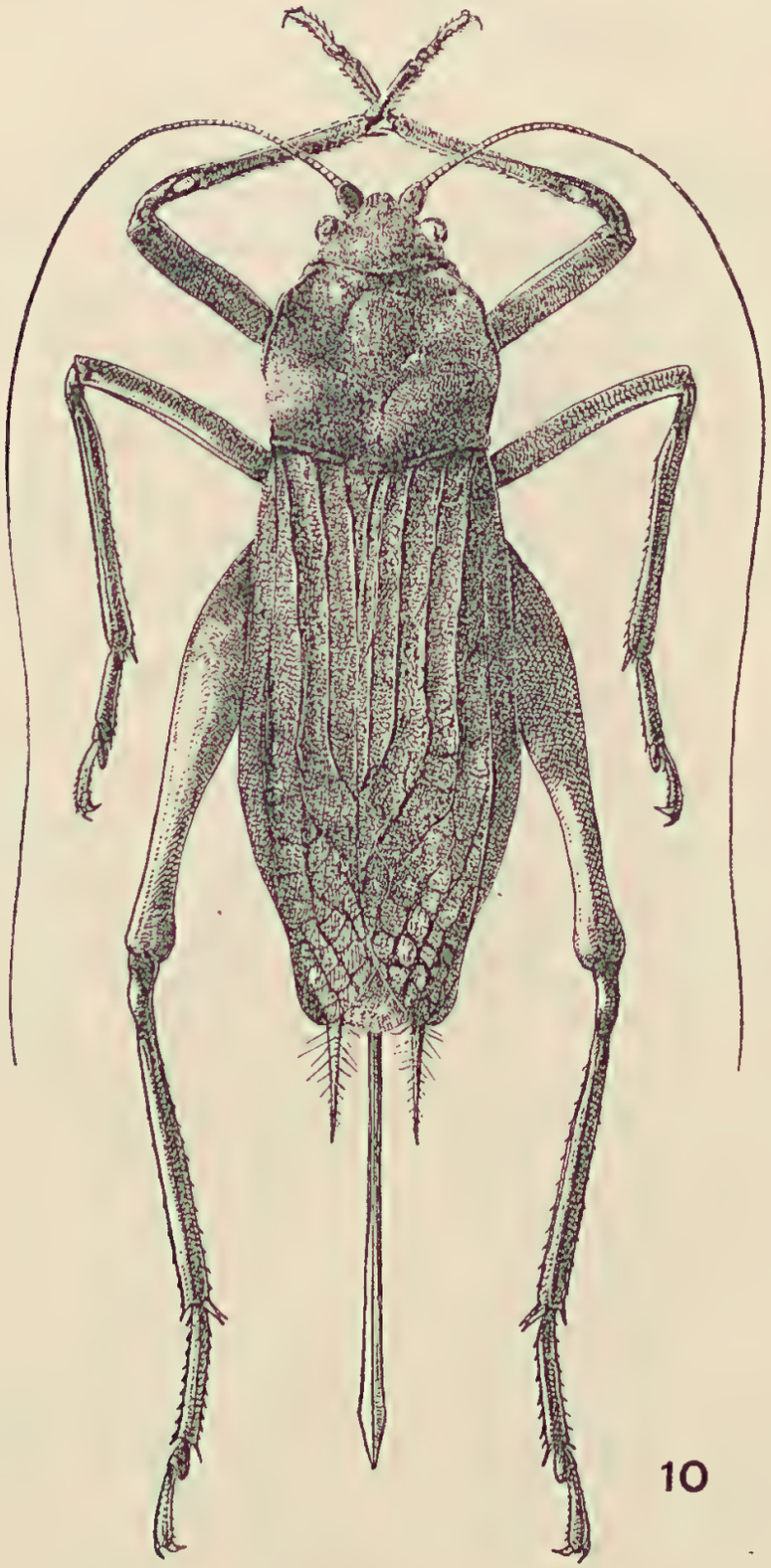


Fig. 10. *Cacoplistes brunnerianus* Sauss. ♀.

CACOPLISTES BRUNNERIANUS (Sauss.).

Cachoplistus brunnerianus Saussure, 1877, Mem. Soc. Geneve, xxv, p. 327, pl. 15 (xxxii), fig. 1–1a, b, t, c, i, s.

Fig. 10.

Black, glabrous; finely punctate. The female only is known; the veins on the elytra are somewhat elevated and there exists between them a very fine net of small veins besides the transverse veinlets. Wings very short.

Length of body 32 mm.; pronot. 8 mm.; post. fem. 16 mm.; elytra 24 mm.

This species is known only from the type specimen in the Brunner collection, labelled Australia, without exact locality.

A second species of this extraordinary genus is cited by Saussure with doubt from Australia, under the name of *Cachoplistus* v. *westwoodianus*. It is close to the preceding one but with longer, half membraneous elytra, longer ovipositor, wings longer than the elytra, anterior angles of the pronotum more rounded.

FAMILY PHALANGOPSIDAE.

This family is composed of rather large species with long legs, posterior tibiae serrulated between the spines. The elytra are often reduced, chiefly in the female sex. Most of the species of Phalangopsidae are hygrophilous; they live in the forests and a certain number inhabit caves.

The family is not very well represented in the Australian fauna, there being two genera only.

KEY TO THE GENERA OF *PHALANGOPSIDAE*.

1. Apterous in both sexes .. .. *Endotaria*
   Elytra present in the male .. .. *Endacusta*

Gen. ENDACUSTA Brunner, 1874.

This genus comprises rather slender species with vertical head; forehead excavated, forming a narrow rostrum. Pronotum transverse with straight posterior margin. Legs rather long; anterior tibiae perforated with an internal tympanum; posterior femora usually with apical third narrow; posterior tibiae armed with 4–5 spines on each margin, serrulated between the spines; supero-internal apical spur as long or longer than the median; supero-external as long or longer than the inferior spine but shorter than the median. Elytra of male shorter than the abdomen, square, with small, triangular mirror, numerous

oblique veins, apical field almost absent; lateral field with few veins. Wings abortive. Female wholly apterous.

KEY TO THE SPECIES OF *ENDACUSTA*.

MALES.

1. Elytra extending to the apex of abdomen, widening somewhat posteriorly with rounded posterior margin; legs rather short 11. *amplipennis*
   Elytra shorter than the abdomen, square, with almost straight posterior margin 2
2. Mirror small, occupying about the apical third of the elytron; internal spurs of the posterior tibiae short .. .. 7. *pilipennis*
   Mirror occupying half the length of the elytron 3
3. Frontal rostrum very wide at base; posterior ocelli separated by a space equalling three times their width 4
   Frontal rostrum narrower; posterior ocelli separated by a space equalling at most twice their width 7
4. Elytra with 2 or 3 oblique veins only 5
   Elytra with 6 to 8 oblique veins 6
5. Mirror rather large, triangular, divided by a transverse vein and with a very wide reticulation in its posterior part (fig. 46); lateral field with 4 veins .. .. 10. *oligoneura*
   Mirror small, strongly transverse; lateral field very much reduced, without veins .. .. 9. *cycloptera*
6. Legs rather short; posterior femora without apical filiform part; frontal rostrum wide at base but very narrow at apex; elytra not longer than wide .. .. 8. *angulifrons*
   Legs longer; posterior femora with distinct apical filiform part; frontal rostrum almost as wide at apex as at base .. .. 6. *irrorata*
7. General colour very dark; elytra almost black; genitalia in the shape of a trident; frontal rostrum rather wide, rounded above .. 5. *mjöbergi*
   General colour testaceous brown varied with brown; elytra testaceous; genitalia notched at apex; frontal rostrum compressed 8
8. Mirror one and a half times as wide as long; oblique veins quite straight and parallel (fig. 49) .. .. 3. *major*
   Mirror scarcely as wide as long; 5 or 6 sinuated and more or less diverging oblique veins (fig. 50) 9
9. Larger (14–16 mm.); frontal rostrum very narrow, compressed; mirror in the shape of an equilateral triangle .. .. .. 1. *australis*
   Smaller (11–12 mm.); frontal rostrum a little wider, not so strongly compressed; internal margin of the mirror a little longer than the other two .. .. 4. *minor*

FEMALES.

1. Frontal rostrum very narrow 2
   Frontal rostrum wider 5

2. Ovipositor much longer than the body; apical valves smooth .. 3
   Ovipositor no longer than the body; apical valves punctated .. 4

3. Larger (16 mm.); apical valves of the ovipositor wider .. 1. *australis*
   Smaller (12 mm.); apical valves of the ovipositor narrow .. 4. *minor*

4. Subgenital plate rather deeply notched at apex with subangulate lobes. Ovipositor as long as the body .. .. 2. *pardalis*
   Subgenital plate scarcely notched at apex with rounded lobes. Ovipositor shorter than body .. ..3. *major*

5. Frontal rostrum as wide at apex than at base .. .. 7. *pilipennis*
   Frontal rostrum narrowing at apex 6

6. Frontal rostrum much narrower at apex than at base, nearly triangular .. .. 8. *angulifrons*
   Frontal rostrum distinctly narrower at apex than at base but much less than the preceding 7

7. Apical valves of ovipositor punctated .. .. .. 6. *irrorata*
   Apical valves of ovipositor smooth 8

8. Internal apical spurs of posterior tibiae long; posterior metatarsi armed with about 10 denticles above .. .. .. 5. *mjöbergi*
   Internal apical spurs of posterior tibiae short; posterior metatarsi armed with 5 or 6 small denticles above 9

9. Frontal rostrum rounded above .. .. 10. *oligoneura*
   Frontal rostrum very wide, flat above .. .. .. 9. *cycloptera*

1. ENDACUSTA AUSTRALIS Sauss.

Endacusta australis Saussure, 1878, Mem. Soc. Geneve, xxv, p. 437, pl. 16 (xlii), fig. 1–5.

Fig. 50, 52.

Fulvo-testaceous varied with brown; pubescent. Frontal rostrum very narrow, compressed. Elytra of male (fig. 50) shorter than the abdomen; mirror triangular; 5 or 6 oblique veins; apical field almost nil; lateral field without any vein. Legs rather long; posterior femora adorned with oblique brown bands. Genitalia of male (fig. 52) long and narrow, roundly notched at apex. Ovipositor much longer than the body with apical valves scarcely wider than the stem, smooth.

Length of body 14–16 mm.; post. fem. 13–15 mm.; ovipositor 24–27 mm.

Victoria: Melbourne (Saussure's type).

Queensland: Brisbane (Q.M.); Almaden, Chillagoe Dist. (W. D. Campbell), (A.M.); Cape Yorke Peninsula (S.A.M.).

South Australia: Salisbury, Grange, Pt. Vincent, Marino, Callington, Pt. Wakefield, Adelaide, Gawler (S.A.M.).

Northern Territory: Darwin (S.A.M.).

Central Australia: Winnecke Coll. (S.A.M.).

2. ENDACUSTA PARDALIS (Walk.).

Zaora pardalis Walker, 1869, Cat. Derm. Salt. Br. M., i, 0, 90 (1).

The description of the genus *Zaora* is based on the female sex only; it is difficult to conceive why W. F. Kirby chose as type of the genus a species known from the male sex only, leaving aside the only species in which the female was described.

This species is very close to the preceding; its colour is strongly mottled with brown but these markings seem very variable in the different species of *Endacusta*. The frontal rostrum is very narrow; the ovipositor is not longer than the body; the subgenital plate of the female is rather deeply notched, with subangulate lobes.

Length of body 15 mm.; ovipositor 14 mm.

Northern Australia: Victoria River (Walker's type).

3. ENDACUSTA MAJOR sp. n.

Fig. 49, 54.

♂. Large species; light testaceous with small, but quite distinct brown spots. Frontal rostrum very narrow, carinate; posterior ocelli rather big, separated by a space scarcely equalling their width; anterior ocellus situated a little before the apex of the rostrum. Face yellow with 4 narrow brown bands, 2 beneath the eyes and 2 shorter ones along the antennal sockets. Maxillary palpi with very long fifth segment scarcely widening at apex and a little darkened. Pronotum transverse, very light with 4 brown spots, 2 along the anterior margin and 2 longer ones near the posterior margin; lateral lobes yellowish with a brown spot in front and another one along the inferior margin; this margin ascending backwards. Abdomen testaceous, mottled with brown; supero-anal valve with rounded posterior margin; subgenital plate very long and narrow at apex, bicarinated. Third abdominal tergite with concave posterior

margin; fourth with a faint thickening in the middle bearing two tufts of rather long hairs. Genitalia rather wide, deeply notched at apex with narrow lobes (fig. 54).

Legs long, ringed with brown. Posterior tibiae armed with 3 internal, 4 external sines; supero-external apical spur shorter than the inferior one. Posterior metatarsi feebly armed, chiefly in the internal margin, which bears 3 to 5 denticles.

Elytra (fig. 49) feebly pubescent, with posterior margin truncated, somewhat sinuated, external apical angle rounded, a little expanded. Mirror large, triangular, a little wider than long, with straight posterior margin, with 2 or 3 small incomplete dividing veins; wrapping vein in the middle between the posterior margin of the mirror and the apical margin of the elytron; diagonal vein short, sinuated; 3 chords, the second being united to the third towards the middle; 7 or 8 oblique veins which are parallel, regularly spaced; lateral field translucent, showing 2 or 3 branches of the subcostal vein, which is furcate at apex.

♀. Apterous; head, pronotum and legs as in the male. Subgenital plates scarcely notched at apex, with rounded lobes. Ovipositor short, solid, with short, wide, rugose apical valves.

Length of body ♂ 21 mm., ♀ 16–20 mm.; pronot. 3·5 mm.; post. fem. ♂ 18·5 mm., ♀ 17 mm.; elytra ♂ 6·8 mm.; ovipositor 9–11 mm.

Types: South Australia: Innaminka, 1 ♂, 1 ♀ (S.A.M.).

This species, large for the genus, is of a pale general colour with rather sparse pubescence. The elytral venation of the male is rather variable, particularly in the number of oblique veins and the disposition of the chords; in one curious individual variation, the first chord is united to the mirror by a small vein, forming a large, rectangular cell. It also differs from the preceding in the supero-external apical spur of posterior tibiae being no longer than the inferior.

South Australia: Cooper's Creek, Chinchilla, Minnie Downs, Marree, Oodnadatta, Magill, Booleroo Centre, Mt. Painter (S.A.M.).

Western Australia: Coolgardie, Alexandria (W. Stalker, iii, 06) (Br. M.); Bowerly (F. W. du Boulay), Mullewa (Miss F. May), Beverley, Coolgardie (S.A.M.).

Central Australia: Hermannsburg (H. J. Hillier, 1911), (S.A.M.).

Northern Territory: Tennant Creek (S.A.M.).

4. ENDACUSTA MINOR sp. n.

Fig. 51, 56.

♂. A rather small species; testaceous brown, varied with more or less marked darker spots. Frontal rostrum a little wider than in the preceding species; anterior ocellus nearly at apex of the rostrum; lateral ocelli separated by a space almost as wide as their width. Face testaceous with a rather narrow brown band beneath each eye and two such bands in the middle of the facial shield, along the antennal sockets. Pronotum transverse with feebly marked brown spots. Abdomen yellowish, mottled with brown; supero-anal valve with rounded posterior margin; subgenital plate rather short, a little notched at apex. Genitalia of the same type as those of *australis*, the lobes formed by the apical notch wider, rounded (fig. 56).

Legs ringed with brown. Posterior tibiae bearing 4 spines on each margin; supero-external apical spur longer than the inferior one.

Elytra (fig. 51) feebly pubescent, with weakly convex posterior margin; mirror large, triangular with sides almost of the same length; diagonal vein feebly sinuate, almost horizontal; wrapping vein almost touching the apical margin of the elytron; chords rather variable in length and dispositon; 5 or 6 oblique veins; lateral field with very weak veins; Sc bearing 3 branches.

♀. Subgenital plate scarcely notched at apex, with rounded lobes. Ovipositor very long and slender with apical valves scarcely wider than the stem, smooth.

Length of body ♂ 11 mm., ♀ 12 mm.; post. fem. ♂ 11 mm., ♀ 12 mm.; elytra ♂ 3 mm.; ovipositor 18 mm.

Types: South Australia: Talia, 1 ♂; Denial Bay, 1 ♀ (S.A.M.).

In the shape of the genitalia and the male elytral venation this species is close to *australis*; but it is much smaller.

South Australia: River Murray, Minnipa, Murat Bay (S.A.M.).

5. ENDACUSTA MJÖBERGI Chopard.

Endacusta mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 28, fig. 61–63.

Fig. 48, 55.

In this species, the dark markings are especially important, sometimes covering almost completely the pronotum. Frontal rostrum wider than in the preceding species. Antennae ringed with yellow. Legs rather long; posterior tibiae armed with 4 spines on each margin; supero-external apical spur shorter

than the inferior one. Elytra of male (fig. 48) nearly black, glabrous; mirror large, triangular; diagonal vein short; 7 or 8 oblique veins. Genitalia in the shape of a trident (fig. 55). Ovipositor almost as long as the body, slender, with short, smooth, acute apical valves.

Length of body ♂ 12 mm., ♀ 13 mm.; post. fem. ♂ 11 mm., ♀ 11·5 mm.; elytra ♂ 4·5 mm.; ovipositor 11 mm.

Queensland: Glen Lamington, Colosseum (types in Stockholm Mus.); Stradbroke Is. (Q.M.).

6. ENDACUSTA IRRORATA Sauss.

Endacusta australis Saussure, 1878, Mem. Soc. Geneve, xxv, 8.

Fig. 53.

This species is very similar to *australis* but with wider frontal rostrum and shorter metatarsi of the anterior and median legs; as in this species, the supero-external apical spur of posterior tibiae is longer than the inferior one. The elytral venation of the male is very similar to the preceding species but the genitalia are a quite different shape, being very similar to *major* (fig. 53). The ovipositor is rather short and stout with scabrous apical valves, as in *major*.

Length of body 14–16 mm.; post. fem. 13–15 mm.; elytra ♂ 5 mm.; ovipositor 9–10 mm.

Queensland: (Saussure's type).

South Australia: Brinkworth, Oodnadatta (S.A.M.).

7. ENDACUSTA PILIPENNIS Chopard.

Endacusta pilipennis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 28, fig. 58–60.

This species is close to *irrorata*, with still wider frontal rostrum, very small elytral mirror in the male; shorter internal apical spurs of posterior tibiae. Male elytra strongly pubescent; ovipositor of female as long as body, slender with smooth, acute apical valves.

Length of body 13–14 mm.; post. fem. 9·5–10 mm.; elytra ♂ 3·5 mm.; ovipositor 13 mm.

Queensland: Malanda (types in the Stockholm Mus.), Atherton, Cedar Creek, Bellenden Ker (Stockholm Mus.); Cairns Distr. (S.A.M.).

Western Australia: Kimberley Distr. (Stockholm Mus.).

8. ENDACUSTA ANGULIFRONS sp. n.

Fig. 47, 57.

♂. Rather large and stout species; colouration rather dark testaceous brown with feebly marked brown spots; finely pubescent. Head as wide as pronotum; vertex strongly convex, separated from the rostrum by a depression; frontal rostrum wide at base but very narrow at apex, flat above; anterior ocellus a little before the apex of the rostrum; lateral ocelli small, wide apart. Face yellowish with a large brown spot beneath the antennal sockets and a little band of the same colour along their internal margin. Antennae brown with a few yellowish rings. Palpi yellowish; fourth segment of maxillary palpi much shorter than the third, fifth very long, feebly enlarged at apex.

Pronotum a little wider than long, with feebly concave anterior and posterior margins; disk convex with four deep furrows delimiting a large, lozenge-shaped median area; lateral lobes for the most part brown, with inferior margin strongly ascending backwards; anterior angle straight but rounded. Abdomen testaceous brown with small darker spots, covered with a yellowish, silky pubescence; supero-anal valve with rounded posterior margin; subgenital plate rather short, deeply notched at apex, with rounded lobes. Genitalia short and wide, rather different from the other species, composed of a superior part, weakly sclerified, roundly notched at apex, and a strongly sclerified inferior part in the shape of a forceps (fig. 57).

Legs rather short and strong. Anterior and median femora thick at base, the anterior ones especially swollen; their colour is brownish with the apex and an ante-apical ring yellowish; tibiae brown with two yellow rings, the anterior ones perforated on internal faces with a small round tympanum; apices armed with two inferior spurs of which the internal is much longer than the external; metatarsus a little longer than the other two segments, brown with yellow base, their inferior margin non carinated, pubescent. Posterior femora rather short and stout with almost no apical filiform part; colour brownish with yellowish apex and pre-apical ring; tibiae annulated with brown, armed with 4 rather short spines on each margin; external apical spurs short, especially the superior one which is much shorter than the last spine and than the inferior one; medio-internal apical spur much longer than the superior; metatarsi long, not carinated beneath.

Elytra (fig. 47) scarcely surpassing the apex of second abdominal tergite, glabrous; internal and external margins convex, apical margin almost straight; anal field short; the anal vein curved; mirror large, incompletely delimited and partly invaded by large, irregular cells; diagonal vein very sinuate and almost

horizontal; chords quite indistinct, lost in the reticulation occupying the space between the mirror and the internal margin of the elytron; 7 parallel oblique veins; lateral field rather high, dark brown, with an irregular venation.

♀. Head and pronotum quite similar to the male; apterous. Ovipositor broken.

Length of body 17·5 mm.; pronot. 3·5 mm.; post. fem. 12·5 mm.; elytra ♂ 5·2 mm.

Types: Lord Howe Is., 1 ♂, 1 ♀ (S.A.M.).

A species very distinct in the shape of the frontal rostrum.

9. ENDACUSTA CYCLOPTERA sp. n.

Fig. 59.

♂. Size medium; rather uniform testaceous brown; finely pubescent. Head rufous brown, without any ornamentation; frontal rostrum short and very wide, flattened above, rounded at top; anterior ocellus a little before the apex; lateral ocelli small, widely separated. Face testaceous with a strongly marked brown band beneath the eyes. Antennae and palpi testaceous; fourth segment of maxillary palpi a little shorter than third, fifth long slender up to the middle then suddenly widening in the shape of a funnel. Eyes piriform.

Pronotum wide, with feebly sinuated anterior margin, a little concave posterior one; disk feebly convex, uniformly rufous brown; lateral lobes very low, a little expanding externally, with slightly ascending backwards inferior margin. Abdomen rufo-testaceous, a little mottled with brown; third tergite with posterior margin rather strongly notched in the middle; supero-anal valve transverse, with truncated posterior margin, rounded angles, lateral margins a little swollen; subgenital plate long, strongly narrowing towards the apex which is roundly notched. Genitalia formed of a superior part rather strongly sclerified, in the shape of a rounded plate, feebly notched at apex, and an inferior part divided at apex into one rounded lobe and the other feebly forked (fig. 59).

Legs rather short, very feebly annulated with brown. Anterior tibiae perforated with a small round tympanum at base of the internal face; tarsi as long as the tibiae. Posterior femora thick at base, with very short apical filiform part; external face feebly striated with brown; tibiae armed with 5 external, 4 internal spines; external apical spurs short, the superior one shorter than the last spine and than the inferior; internal spurs rather long, the superior a little shorter than the median one.

Elytra extending no farther than the apex of third abdominal tergite, finely pubescent, with internal and apical margins rounded; mirror small, strongly transverse with convex posterior margin; chords short; 2 or 3 oblique veins; lateral field reduced, without any vein. Wings abortive.

♀. Apterous; similar to the male but with a little darker colouration; the third abdominal tergite is not notched. Ovipositor broken.

Length of body 14 mm.; pronot. 2·5 mm.; post. fem. 11 mm.; elytra ♂ 3·9 mm.

Types: New South Wales: Nepean River (A. Musgrave, 6, iii, 1920), 1 ♂, 1 ♀ (A.M.).

This species is very distinct from the other species of the genus in its feebly depressed shape and especially in the elytral venation.

10. ENDACUSTA OLIGONEURA sp. n.

Fig. 46, 60.

♂. *Holotype.* Rather small with well defined brown markings. Head with a median brown band above; frontal rostrum rather wide, rounded above. Face brown with a wide yellow band in the middle and another one under each eye. Eyes projecting, strongly narrowing in their inferior part; ocelli small, the posterior ones separated by a distance at least double their width. Antennae brown with small yellow rings. Palpi brownish; fourth segment of the maxillary palpi much shorter than the third, fifth longer than the third, rather strongly enlarged at apex, with superior margin feebly concave. Pronotum nearly twice as wide as long; disk feebly convex, furrowed in the middle and with two brown rounded prominences; lateral lobes dark brown with inferior margin slightly ascending backwards. Abdomen brown, marbled with yellowish; supero-anal valve transverse with feebly notched apical margin; subgenital late long, narrowing before the apex, with two lateral valves in the shape of a forceps and a superior part tridentated (fig. 60).

Legs rather short, annulated with brown. Posterior femora thick, without apical filiform part; spines of the tibiae short, 3 internal, 4 external; external apical spurs short, the median a little longer than the other two, the superior a little shorter than the inferior; median and superior internal spurs rather long, pubescent, the superior slightly exceeding the median. Metatarsi long, feebly compressed, armed above with 5 small external spines, 1 apical internal one.

Elytra (fig. 46) rounded at apex, nearly glabrous, brown with light veins; mirror rather large, triangular with convex posterior margin, with a very wide

irregular reticulation extending nearly to the middle; chords almost straight; 2 or 3 oblique veins; diagonal vein rather low, brown, Sc vein thick, bearing 4 rather distinct branches.

♀. *Allotype*: New South Wales: National Park, The Cabin (A. Musgrave, April, 1933), (A.M.).

Similar to the male; apterous. Ovipositor with apical valves narrow ovo-lanceolate, acute. Subgenital plate with straight posterior margin.

Length of body 11–11·5 mm.; pronot. 2–2·1 mm.; post. fem. 9–9·2 mm.; elytra ♂ 5·5 mm.; ovipositor 8 mm.

Type: New South Wales: Dorrigo (W. Heron), 1 ♂ (S.A.M.).

Like the preceding, this species differs from the other species of *Endacusta* in the small number of oblique veins in the elytral venation; the elytra are relatively very large and almost glabrous whereas in *cycloptera* they are finely pubescent.

11. ENDACUSTA AMPLIPENNIS (Chop.).

Parendacusta amplipennis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 30, fig. 64, 66.

This species differs markedly from the other species of the genus in the shape of the male elytra which are very wide and extend to the apex of abdomen with a very transverse mirror, divided by a curved vein. The legs are rather short; interno-apical spurs of the posterior tibiae short, the two large ones subequal in length.

Length of body 8·5 mm.; post. fem. 7·5 mm.; elytra 6 mm.

Queensland: Cedar Creek (type in the Stockholm Mus.).

Gen. ENDOTARIA nov.

Both sexes apterous. Head with short, rather wide frontal rostrum. Legs rather long, anterior tibiae perforated on internal faces, posterior femora rather thick, with almost no apical filiform part; posterior tibiae armed with 4 short spines on each margin; externo-apical spurs short, the superior shorter than the inferior, the median the longest; internal spurs also rather short, the superior only a little shorter than the median.

This genus is completely apterous like *Arachnopsis* Sauss. but with perforated anterior tibiae and shorter legs; it seems rather close to *Endacusta*.

Type: *Endotaria aptera* sp. n.

ENDOTARIA APTERA sp. n.

Fig. 8, 61, 62.

♂. Dark brown, varied with testaceous; pubescent. Head scarcely as wide as pronotum, adorned with 4 yellow lines, uniting two by two posteriorly; frontal rostrum short, feebly convex above, rather wide; anterior ocellus almost at apex of the rostrum; lateral ocelli separated by a distance equalling thrice their width. Face shining brown with a yellow median band, widening towards the clypeus; genae adorned with two yellow spots. Eyes piriform, feebly projecting. Antennae brownish with a few feebly marked light rings; their first segment brown, shining. Palpi brown; fourth segment of the maxillary palpi a little shorter than third, fifth large, feebly widening at apex.

Pronotum transverse widening a little in front, with straight anterior margin, posterior feebly notched in the middle; disk feebly convex, furrowed in the middle, mostly testaceous with a few brown spots, two large rounded ones near the middle of the anterior margin; lateral lobes black, their inferior margin ascending backwards, anterior angle rounded, somewhat projecting outwards. Abdomen almost wholly brownish, the posterior margin of the first tergites tinged with yellow and adorned with rounded brown spots; supero-anal valve light brown, rounded at apex; subgenital plate rather short, rounded at apex, not carinated. Genitalia with a narrow long superior plate and two inferior pieces curved outside (fig. 61).

Legs rather short, strongly annulated with brown. Anterior and middle femora somewhat swollen; anterior tibiae with a small round tympanum near the base of internal face; metatarsi a little longer than the other two segments, brown in their apical half, carinated beneath on their whole length. Posterior femora swollen at base, gently narrowing towards the apex, striated with brown externally and adorned with three oblique brown bands; tibiae adorned with 3 brown rings; metatarsi armed with 6–7 denticles on the supero-external margin, 2 or 3 only on the internal one.

Length of body 12·5 mm.; pronot. 2·4 mm.; post. fem. 9·5 mm.

Type: New South Wales: Upper Williams River (Lea and Wilson, Oct. 1926), 1 ♂ (S.A.M.).

FAMILY OECANTHIDAE.

The Oecanthidae differ from the other Grylloidea in so many features that they can be as well considered as a distinct family. They are very slender insects with a long, almost horizontal head; elytra of the male wide, almost

transparent, with a large mirror divided by a transverse vein; posterior legs very slender, the tibiae serrulated along their whole length, armed or not with small spines.

KEY TO THE GENERA OF *OECANTHIDAE*.

Posterior tibiae armed with small spines in addition to the general denticulation .. .. *Oecanthus*

Posterior tibiae serrulated but without spines .. .. *Xabea*

Gen. OECANTHUS Serville, 1831.

Generic diagnosis as for the family; the genus is cosmopolitan.

KEY TO THE SPECIES OF *OECANTHUS*.

Large; elytral mirror of the male one and a half times as long as wide; elytra of female wider with somewhat oblique veins .. .. 1. *rufescens*

Smaller; elytral mirror of male nearly twice as long as wide; elytra of female very narrow, with parallel longitudinal veins .. 2. *angustus*

1. OECANTHUS RUFESCENS Serville.

Oecanthus rufescens Serville, 1839, Ins. Orth., p. 361; Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 31.

Rather large, whitish with almost transparent wings; elytra narrow at base but rather strongly widening backwards. Wings longer than the elytra.

Length of body 14·5–16 mm.; length with wings 20–23 mm.; elytra 12–14 mm.; ovipositor 7·5–9 mm.

This species is widely distributed in the Indo-Australian region.

Queensland: Yarrabah (Stockholm Mus.); Stradbroke Island (Q.M.).

South Australia: Minnie Downs, Mt. Lofty (S.A.M.).

Torres Straits: Moa Island (S.A.M.).

2. OECANTHUS ANGUSTUS Chopard.

Oecanthus angustus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 32, fig. 65.

Smaller than the preceding and much more narrow. Pronotum with parallel sides; elytra of male with mirror nearly twice as long as wide, divided by a transverse vein at about the anterior third; elytra of female forming an almost cylindrical case, with 6 longitudinal, parallel veins. Ovipositor short, straight, with tridentate apical valves.

Length of body 11 mm.; length with wings 18 mm.; elytra 11 mm.; ovipositor 5 mm.

Western Australia: Kimberley Distr. (type in the Stockholm Mus.).

Central Australia: Storm Creek, Urimilla Springs (S.A.M.).

South Australia: Minnipa, Hermannsburg (S.A.M.); Killalpaninna, 100 miles E. of Lake Eyre (H. Hillier, 1905), (Br. M.).

Gen. XABEA Walker, 1869.

The species of this genus have exactly the same aspect as those of *Oecanthus* from which they differ only in the armature of the posterior tibiae. The genus is represented by a few Malaisian species and the new Australian species described below.

XABEA LEAI sp. n.

Rather small, slender. Head as long as the pronotum, testaceous with 4 brown longitudinal lines above, of which the two median are the longest, united forwards by a transverse band; frontal rostrum a little narrower than the first antennal segment. Face triangular, widening at base of mandibles. Eyes lengthened, projecting. Antennae and palpi testaceous; fifth segment of maxillary palpi very long and slender.

Pronotum long, a little narrowing in its anterior half; anterior margin convex, posterior almost straight; disk rather strongly swollen behind the middle, adorned with two longitudinal brown bands; lateral lobes with strongly sinuated inferior margin. Abdomen yellowish; tenth tergite with sinuate posterior margin; supero-anal valve truncate at apex; subgenital plate with posterior margin rounded and darkened. Cerci relatively short, sinuate, with a swelling towards the middle, a little rounded at apex, ending in a dainty spine.

Legs long, yellowish; posterior femora somewhat reddish at apex. Elytra narrow, transparent, with 3 brown spots, one on the anal knot, the other two in front and back of the mirror, which is longer than wide, strongly angulate in front, rounded behind and on the sides, divided in the middle by a vein which is strongly bent towards the external end; first chord almost straight, united to the diagonal vein by a small vein near the base; second chord united to the first at base, ending on the third a little after the middle; in addition, it is united to this same third chord by a veinlet; 4 oblique veins; anal vein broken at right angle; lateral field rather high; Sc bearing 4 branches; at the junction of the dorsal and the lateral fields; the median vein is strongly sinuate at base so that there is a very large space between this and the cubital vein. Wings longitudinally caudate, somewhat darkened.

♀. Head, pronotum and legs as in the male. Elytra narrow, yellowish testaceous; dorsal field with rather confused venation, forming areolae which are rather irregular, most of them pentagonal in shape; cubital vein bearing 5 branches, almost lost in the general reticulation; lateral field transparent; Sc bearing 4 branches. Subgenital plate small, angulate, furrowed in the middle. Ovipositor short, straight; superior apical valves oval, adorned with concentric ridges; inferior valves longer, bidentate.

Length of body 11 mm.; length with wings ♂ 15 mm., ♀ 16 mm.; post. fem. 8 mm.; elytra 8 mm.; ovipositor 5·5 mm.

Types: Cairns Distr. (A. M. Lea), 1 ♂, 1 ♀ (S.A.M.).

FAMILY TRIGONIDIIDAE.

This family is composed of a considerable number of small species, having a very characteristic general aspect with long posterior legs, tibiae armed with 3 long, movable spines on each margin and 5 apical spurs only. The elytral tympanum of the male presents a large, rhomboid, undivided mirror and a single oblique vein; but the venation is very often similar in both sexes, the male elytron with no mirror. The ovipositor is short, strongly compressed and curved upwards.

KEY TO THE GENERA OF *TRIGONIDIIDAE*.

1. Elytra glabrous 2
   Elytra covered with a fine pubescence 7

2. Elytral mirror well developed in male 3
   Elytral mirror incomplete or absent in male 5

3. Pronotum narrowing in front .. .. *Homoeoxipha*
   Pronotum with almost parallel sides 4

4. Elytra of male transparent, those of the female horned and strongly convex .. .. *Paratrigonidium*

   Elytra of similar texture in both sexes, those of the female feebly convex .. .. *Anaxipha*

5. Pronotum rounded in front; anterior and median legs very slender; anterior tibiae not perforated; elytra shorter than the abdomen .. *Dolichoxipha*[1]

   Pronotum with anterior margin not so strongly convex; anterior and middle legs not so slender; anterior tibiae perforated with at least an external tympanum; elytra usually extending to the apex of abdomen 6

[1] Although the male of this species is unknown, it is very probable that it belongs to this section.

6. Elytral venation somewhat different in both sexes .. *Trigonidomorpha*
   Elytral venation quite similar in both sexes .. .. .. *Metioche*

7. Elytra of male with distinct mirror .. .. .. *Cyrtoxiphoides*
   Elytra of male without mirror 8

8. Elytral veins longitudinal, parallel; fifth segment of maxillary palpi very short; eyes lengthened antero-posteriorly. Vertex flattened .. *Metiochodes*

   Elytral veins more or less oblique, usually a little anastomosed; fifth segment of maxillary palpi long; eyes rounded; vertex convex .. *Amusurgus*

Gen. ANAXIPHA Saussure, 1874.

Fig. 64.

Elytra of male membranaceous, with a large mirror; those of the female with longitudinal veins. Pronotum narrowing feebly in front with an almost straight anterior margin.

The species of this genus are rather numerous in the tropical countries of the world; three only have been found as yet in Australia.

KEY TO THE SPECIES OF *ANAXIPHA*.

1. Eyes lengthened anteriorly and posteriorly .. .. 3. *anaxiphoides*
   Eyes globular, feebly lengthened dorsally and ventrally 2

2. Elytral mirror of the male almost twice as long as wide .. 1. *longipennis*
   Elytral mirror of the male one and a half times as long as wide .. 2. *mjöbergi*

ANAXIPHA LONGIPENNIS (Serv.)

Trigonidium longipennis Serville, 1839, Ins.

This very small species is a uniform pale yellow; in the male the elytral mirror is very large but rather narrow; in the female the elytral venation is composed of 5 straight veins with few transverse veinlets; the ovipositor is rather slender with apical valves occupying half the total length. Wings very elongately produced.

Length of body 5 mm.; length with wings 9·5 mm.; ovipositor 1·8 mm.

This species occurs throughout the whole Indo-Malaisian region.

Queensland: Cairns Distr., Home Hill (S.A.M.); Home Hill (Q.M.).

2. ANAXIPHA MJÖBERGI Chopard.

Anaxipha mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 41, fig. 86.

This species is a little larger than the preceding and is a little more brown-

ish in colour, instead of pure yellow; the elytral mirror of the male is very large and wider.

Length of body 6·5 mm.; length with wings 11·5 mm.; post. fem. 5 mm.

Queensland: Bellenden Ker (type in the Stockholm Mus.).

3. ANAXIPHA ANAXIPHOIDES (Chop.).

Cyrtoxipha anaxiphoides Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 43, fig. 88–89.

This species is very similar to *longipennis* in general shape and colouration; but differs from it in the shape of the eyes, which are not globular but distinctly elongated antero-posteriorly. This character is suggestive of the genus *Cyrtoxipha* and for that reason, the species had been ascribed to this genus. But the other characters are rather those of a true *Anaxipha* so that it seems more correct to remove it to this genus.

Length of body 6 mm.; length with wings 10·5 mm.; post. fem. 4 mm.; ovipositor 2 mm.

Queensland: Bellenden Ker (types in the Stockholm Mus.).

Gen. HOMOEOXIPHA Saussure 1874.

The species of this genus are very similar to those of the preceding, but differ in the shape of the pronotum which is strongly narrowing in front with very convex anterior margin. The elytra of the female shows false veins between the principal veins.

HOMOEOXIPHA LYCOIDES (Walk.).

Phyllopalpus lycoides Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 71; Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 40.

Queensland: Bellenden Ker (Stockholm Mus.); Cairns Distr. (A. M. Lea), (S.A.M.).

Northern Territory: Groote Eylandt (Br. M.).

This species is common in the Indo-Malaisian region.

Gen. PARATRIGONIDIUM Brunner, 1893.

The principal differences between this genus and the preceding lie in the shape of the pronotum and in the more convex elytra of the female, without false veins between the principal veins.

PARATRIGONIDIUM FUSCOCINCTUM Chopard.

Paratrigonidium fuscocinctum Chopard, 1925, Treubia, vi, p. 151.

Queensland: Dunk Is. (H. Hacker, Aug. 1927), (Q.M.); Cairns (S.A.M.).

This species was described from Java and is found in the Malay Archipelago.

Gen. TRIGONIDOMORPHA Chopard, 1925.

In this genus, the male elytron has no distinct mirror but the veins are not regular as in the female; they form large cells and the anal vein is well differentiated.

TRIGONIDOMORPHA SJÖSTEDTI Chopard.

Trigonidomorpha sjöstedti Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 40, fig. 83–85.

This small species is black with testaceous legs; the elytra are black, shining. The general shape is almost the same in both sexes but in the male the elytral veins show a very distinct anal vein; in the female they are somewhat irregular, oblique, 4 in number, with few transverse veinlets.

The single male from Stradbroke Is. represents the macropterous condition; its elytra are longer, lighter in colour but with similar venation; as is usually the case in macropterous specimens, the anterior tibiae are perforated on both sides.

Queensland: Cedar Creek, Yarrabah (types in the Stockholm Mus.); Evelyne, Malanda, Colosseum (Stockholm Mus.); Stradbroke Is. (S.A.M.); Brisbane (Q.M.).

Lord Howe Is. (S.A.M.).

Gen. METIOCHE Stål, 1877.

The genus *Metioche* comprises those species in which the elytral venation is absolutely similar in both sexes and the male elytron shows no trace of differentiation in the veins in most of the species.

KEY TO THE SPECIES OF *METIOCHE*.

1. Black with yellow legs .. .. 4. *australiana*
   Colouration not as above 2
2. Posterior femora adorned with two brown bands; elytra with most longitudinal veins approximated in pairs .. .. .. 5. *parinervis*
   Posterior femora unicolorous; elytral venation different 3

3. Elytral veins of male tending to form small areolae and a very rudimentary stridulating apparatus .. .. 9. *areolata*
Elytral venation much more regular in both sexes 4

4. Elytral veins strong and quite parallel .. .. .. 10. *rectinervis*
Elytral veins not so strong and more or less oblique 5

5. Testaceous with a dark lateral band 6
Testaceous or brown without very distinct dark lateral band or with a light band 7

6. Pronotum narrowing in front .. .. 6. *angusta*
Pronotum with parallel sides .. .. 7. *infuscata*

7. Dark brown with a white opaque lateral band .. .. 8. *albovittata*
Testaceous more or less varied with brown or dark brown varied with testaceous 8

8. Wings usually longer than the elytra; anterior tibiae perforated .. 9
Wings abortive; anterior tibiae without tympana .. .. 2. *flavipes*

9. Head black with small yellow line along the eyes; pronotum blackish; legs yellow; elytra and anterior part of the wings very dark brown .. 3. *bicolor.*
Head and pronotum dark brown varied with testaceous; elytra and anterior part of wings usually testaceous .. .. .. 1. *vittaticollis*

1. METIOCHE VITTATICOLLIS (Stål).

Trigonidium vittaticolle Stål, 1860, Freg. Eugen. Resa, Ins., p. 317.

Metioche vittaticollis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 32, fig. 68, 70.

The colouration of this small species is rather variable and some specimens are almost as dark as those of *M. bicolor*; it can be distinguished by the first two segments of the antennae being black and by the elytral venation being a little more regular.

This is a typically Malaisian species which is common in all the islands of the Malay Archipelago and in Oceania.

Northern Territory: Groote Eylandt (J. H. Wikins, i, 1925), (Br. M.).

Queensland: Cape Yorke (Stockholm Mus.); Blackall River, Cairns Distr., Rockhampton, Dunk Is. (A. J. Turner), (Q.M.); Cairns Distr., Rockhampton (S.A.M.).

METIOCHE VITTATICOLLIS INSULARIS Sauss.

Homoeoxiphus insularis Saussure, 1878, Mem. Soc. Geneve, xxv, p. 470.

Metioche vittaticollis insularis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 32, fig. 67, 70, 71.

I consider this insect as the micropterous condition of the preceding; it is found in the same localities.

Queensland: Bellenden Ker, Malanda (Stockholm Mus.).

2. METIOCHE FLAVIPES (Sauss.).

Trigonidium flavipes Saussure, 1878, Mem. Soc. Geneve, xxv, p. 465, pl. 16, fig. xlvii.

Metioche vittaticollis flavipes Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 33, fig. 72–73.

This species has the same general shape and colouration as the preceding from which it differs only in that the anterior tibiae are not perforated and the elytra are a little shorter and more convex. It may be a second form of the micropterous condition of *vittaticollis*.

Queensland: Bellenden Ker, Yarrabah, Rockhampton (Stockholm Mus.); Gayndah (S.A.M.).

New South Wales: Dorrigo (S.A.M.).

3. METIOCHE BICOLOR (Stål).

Trigonidium bicolor Stål, 1860, Eugenie's Resa, Ins., p. 317.

Metioche bicolor Chopard 1925, Ark. f. Zool., 18A, No. 6, p. 33, fig. 75.

As previously pointed out, this species is very close to the preceding and sometimes difficult to differentiate from the dark forms of *vittaticollis*. It also has a Malayan origin.

Queensland: Evelyne (Stockholm Mus.); Brisbane (Q.M.); Stradbroke Is. (S.A.M.).

4. METIOCHE AUSTRALIANA Chopard.

Metioche australiana Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 36, fig. 77, 80.

This small species is again very close to the preceding ones but it is quite black with yellow legs; the elytra are black or brown; the anterior tibiae are not perforated in the type specimens but there may be a winged condition with tympana.

Queensland: Herberton (types in the Stockholm Mus.).

5. METIOCHE PARINERVIS Chopard.

Metioche parinervis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 34, fig. 76, 79.

Although similar to the preceding, this species differs from them in the colouration which is not so uniform and chiefly in the disposition of the elytral

veins which are almost straight, parallel, the first and second and the third and fourth closer together than the distance between the two groups thus formed.

Queensland: Herberton (type); Atherton, Bellenden Ker, Alice River, Cape Yorke (Stockholm Mus.).

var. *ornata* Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 36.

Differing from the type in its more varied colouration; head with two large brown spots and 2 or 3 smaller ones; pronotum with wide brown bands; posterior femora with well marked transverse brown bands.

Queensland: Bellenden Ker, Cedar Creek, Malanda (Stockholm Mus.).

6. METIOCHE ANGUSTA Chopard.

Metioche angusta Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 37, fig. 81.

A little larger than the preceding ones, this species is long, narrow, testaceous brown with a dark lateral band extending from the head to the extremity of the elytra; these are brownish with lighter veins which are rather regularly spaced, almost longitudinal. Wings very long.

Length of body 6 mm.; length with wings 10 mm.; elytra 5 mm.; post. fem. 4·5 mm.; ovipositor 2 mm.

Queensland: Herberton (type in the Stockholm Mus.).

7. METIOCHE INFUSCATA Chopard.

Metioche infuscata Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 37, fig. 82.

This species has almost the same colouration as the preceding; it differs from it in the disposition of the elytral veins which are somewhat like those of *parinervis*.

Length of body 5·5–6 mm.

8. METIOCHE ALBOVITTATA sp. n.

♀. Brownish, shining, with a white opaque band along the elytral edge. Head brown with the sides of the frontal rostrum yellowish. Face dark brown, shining, with a transverse yellow band going from one eye to the other. Antennae and palpi brown; last segment of the maxillary palpi in the shape of a very long triangle. Eyes slightly lengthened anteriorly and posteriorly; ocelli very small. Pronotum transverse with almost parallel sides, anterior margin straight, posterior feebly convex; disk slightly convex, a little furrowed in the middle; brownish with a somewhat irregular yellowish band on each side; surface finely pubescent; lateral lobes dark brown with inferior margin slightly

ascending backwards. Abdomen brownish; subgenital plate yellowish, large, markedly narrowing backwards with apex almost acute. Ovipositor short, with apical valves occupying nearly half the total length, the superior ones strongly denticulated. Legs yellowish, pubescent. Anterior and medium femora with a weak brown ring before the apex. Posterior femora rather stout, uniformly rufous; tibiae a little darkened at base of the spines; these are rather short, yellowish at base, brown at apex. Elytra a little longer than the abdomen, dark brown, shining with an ivory white opaque band along the edge, narrowing towards the apex; dorsal field with 5 almost longitudinal veins, the 2 internal veins uniting towards the middle, the third and fourth curled at apex, fifth a little more apart, especially near the end; transverse veinlets scarce, forming large, long alveolae; lateral field blackish brown with 4 veins, one of which is incomplete. Wings caudate, brown.

♂. Similar to the female but with short wings (micropterous condition of the species); elytra not longer than the abdomen; subgenital plate somewhat notched at apex.

Length of body ♂ 4·2 mm., ♀ 5 mm.; length with wings ♀ 9 mm.; post. fem. 3·5 mm.; elytra ♂ 3 mm., ♀ 4 mm.; ovipositor 2 mm.

Type: South Australia: Lucindale (A. M. Lea), 1 ♀; Western Australia 1 ♂ (S.A.M.).

This small species has a very characteristic colouration. In addition to the types, there is one male in the South Australian Museum collection from Hobart (C. Cole).

9. METIOCHE AREOLATA Chopard.

Metioche areolata Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 38, fig. 78.

This is a light brown, elongate species, with head adorned with two longitudinal brown bands; the elytral venation differs somewhat from the usual *Metioche* type; in the male the dorsal field has 4 veins, the first is sutural, furcate at base; the second is also divided at base, then forming a small square cell, again divided and forming another long cell, finally almost straight to the apex; the anal vein is rather distinct and curved, somewhat suggestive of those species in which the mirror is normally developed.

Length of body 5 mm.; elytra 4 mm.

Queensland: Mt. Tambourine (type in the Stockholm Mus.).

10. METIOCHE RECTINERVIS sp. n.

♀. Yellowish with a few brownish and reddish spots; almost glabrous. Head adorned above with 4 reddish lines, of which the two median are produced

to the apex of the rostrum; vertex convex; frontal rostrum short, rounded. Face yellow with two reddish spots beneath the eyes and two small lines of the same colour on the facial shield. Antennae and palpi yellowish brown; fourth segment of maxillary palpi a little shorter than third, fifth large, in the shape of a lengthened triangle. Pronotum transverse, with parallel sides, straight anterior and posterior margins; disk feebly convex, yellow, with two large, irregular light brown spots; there are a few setigerous reddish points near the median line and along the posterior margin; lateral lobes light brown, with feebly concave inferior margin and rounded angles. Abdomen yellow with blackish extremity; cerci yellow. Ovipositor short, with rather strongly denticulate valves, occupying nearly half the total length.

Legs yellow, pubescent, rather long. Posterior femora short and stout, with two feebly distinct brown spots above and a small spot near the apex of internal face; tibiae bearing long and slender spines. Elytra extending to the apex of abdomen, light brown with yellow longitudinal, projecting veins; transverse veinlets few in number and feeble; lateral field dark brown. Wings aborted.

Length of body 5 mm.; post. fem. 4·3 mm.; ovipositor 2·9 mm.

Type: Queensland: Mount Glorious (H. Hacker), 24, v, 1930, 1 ♀ (Q.M.); Gold Creek (H. Hacker, 10, vi, 28), 1 ♀ paratype (Paris Mus.).

This species is placed tentatively in the genus *Metioche*; the male may possess an elytral mirror, in which case it would be an *Anaxipha*. On the other hand, the disposition of the elytral veins is suggestive of the genus *Rhicnogryllus*, although these veins are not so prominent as in this genus.

Gen. DOLICHOXIPHA nov.

I erect this new genus for a species which I described in 1925 as an *Anaxipha*, pointing out its very remarkable features; pronotum rounded in front, legs very long, especially the anterior and median tibiae which are very slender, the anterior ones not perforated; elytra much shorter than the abdomen with parallel veins on the dorsal field. The male is unknown but it is improbable that it possesses an elytral mirror.

DOLICHOXIPHA GRACILIPES (Chop.).

Anaxipha gracilipes Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 41, fig. 87.

Yellow, glabrous, shining. Ovipositor rather long, feebly curved, with apical valves shorter than half the total length.

Length of body 6 mm.; post. fem. 4·5 mm.; elytra 3 mm.; ovipositor 3 mm.

Queensland: Bellenden Ker (type in the Stockholm Mus.).

Gen. CYRTOXIPHOIDES nov.

Fig. 63.

General shape rather short; elytra pubescent; wings slightly exceeding the elytra. Vertex flattened. Eyes horizontally lengthened; fifth segment of maxillary palpi very short. Type: *Cyrtoxiphoides leai*, sp. n.

The species of this genus show, as in *Anaxipha*, a well developed mirror on the male elytra but these are covered with a fine pubescence and the shape of the head is different (fig. 63); the fifth segment of the maxillary palpi is very short and funnel-like as in the American genus *Cyrtoxipha* in which the elytra are glabrous.

KEY TO THE SPECIES OF *CYRTOXIPHOIDES*.

Edges of the frontal rostrum thickened, callous; fifth segment of maxillary palpi securiform; face wider than high; elytra of female extending nearly to the apex of the ovipositor, with parallel veins .. 2. *planifrons*

Edges of the frontal rostrum smooth; fifth segment of maxillary palpi triangular; face as high as wide; elytra of female extending to the apex of abdomen, with somewhat irregular veins .. .. .. 1. *leai*

1. CYRTOXIPHOIDES LEAI sp. n.

Fig. 9.

♂. Small; yellow, pubescent. Head wide; vertex flattened, sloping; frontal rostrum a little narrower than the first antennal segment. Face triangular, short and wide, yellow, shining. Eyes a little lengthened anteriorly and posteriorly; ocelli very small, the anterior one at apex of the rostrum. Antennae and palpi yellow; maxillary palpi with fourth segment shorter than third, fifth very short, triangular, with inferior angle a little more acute than the superior one. Pronotum strongly transverse, with parallel sides, anterior margin convex, posterior one straight; disk nearly flat, pale yellow, sprinkled with rufous bristles; lateral lobes concolorous, with straight inferior margin, rounded angles. Abdomen yellow; subgenital plate strongly notched at apex. Cerci yellow, a little thickened and flattened at base, showing traces of segmentation. Legs light yellow, finely pubescent. Anterior tibiae perforated both sides, with an oval tympanum, the internal one larger. Posterior femora

rather long and slender; tibiae with rather short spines, a little hooked at apex and feebly darkened above. Elytra hardly overreaching apex of abdomen, narrow, yellow, very pubescent; mirror very long and narrow, with very acute anterior angle; diagonal vein rather short and almost straight; chords long, almost straight, united at base; lateral field almost transparent, with 3 regularly spaced veins. Wings a little longer than the elytra, marginal field pubescent with a few brown spots.

♀. Similar to the male. Dorsal field of the elytra with 4 oblique, somewhat irregular veins; transverse veinlets rather numerous, forming large, nearly square areolae. Ovipositor long, narrowing before the apical valves which occupy half the total length, their margins being parallel and denticulate at apex only.

Length of body 5·5 mm.; length with wings 9 mm.; post. fem. 4·8 mm.; elytra 4·8 mm.; ovipositor 3·2 mm.

Types: Queensland: Cairns Distr. (A. M. Lea), (S.A.M.).

This species resembles very closely the American *Cyrtoxipha* in the shape of the eyes and of the maxillary palpi; the width of the pronotum and the large head give this insect a special habitus.

2. CYRTOXIPHOIDES PLANIFRONS sp. n.

Fig. 65.

♀. Yellowish, pubescent. Head a little wider than pronotum, strongly depressed above; frontal rostrum rather wide, bordered with a yellow, slightly callous line. Face short and very wide, yellow. Eyes a little lengthened anteriorly and posteriorly; ocelli very small. Antennae and palpi yellow; fourth segment of maxillary palpi much shorter than third, fifth short, strongly enlarged at apex with longitudinally oval section, the superior margin much shorter than the inferior. Pronotum transverse, with sinuated posterior margin; lateral lobes with straight inferior margin, and slightly rounded angles. Abdomen yellow; subgenital plate wide with feebly notched posterior margin. Ovipositor long with apical valves occupying half the total length, the superior ones coarsely denticulate towards the apex (fig. 65). Legs of the same colour as the body. Posterior femora rather short, thick at base; tibiae armed with short spines. Elytra extending to the apex of ovipositor, yellow, pubescent; dorsal field with 5 almost parallel, feeble oblique veins, of which the second is furcate in about the apical fourth; lateral field with 4 veins, of which one is incomplete. Wings just surpassing the elytra.

Length of body 5·5 mm.; length with wings 9·5 mm.; post. fem. 5 mm.; elytra 5·5 mm.; ovipositor 2·9 m.m.

Type: Queensland: Dunk Is. (H. Hacker, Aug., 1927), 1 ♀ (Q.M.).

Although very similar to the preceding, this species is easily distinguished by the longer elytra with more regular veins, the strongly securiform apical segment of maxillary palpi.

Gen. AMUSURGUS Brunner, 1893.

The species of this genus as in *Cyrtoxiphoides* have the elytra covered with a fine pubescence but the male never possesses a distinct tympanum; nevertheless, the elytral veins are not parallel but more or less anastomosed, forming a few large cells. The eyes are rounded, not at all lengthened anteriorly and posteriorly.

One Australian species only can be ascribed to this genus.

AMUSURGUS FASCIFRONS sp. n.

Fig. 11.

♂. Shape narrow and long; colour testaceous brown with a dark lateral band; finely pubescent. Head a little wider than pronotum in front; vertex convex, spotted with reddish brown; frontal rostrum short, as wide as first antennal segment; face triangular, rather long, with two small brown bands between the antennae and on the clypeus, and a wide slightly curved fascia going from the inferior point of one eye to that of the other. Antennae yellow, with small brown rings, the first segment spotted with brown on internal face. Palpi yellowish with darkened last segment; fourth segment of maxillary palpi slightly shorter than third, fifth triangular, long. Eyes rounded; ocelli rather large, circled with brown, the anterior a little before apex of rostrum. Pronotum transverse, a little narrowing in front; disk convex, yellowish with two large reddish brown spots along the anterior and posterior margins; these two spots united by a very narrow line of the same colour; along the posterior margin a row of brown spots each bearing a long bristle; lateral lobes brown with much rounded anterior angle. Abdomen yellow; cerci very long. Legs rather long, yellow, pubescent. Anterior and medium tibiae adorned with an apical brown spot and a small ante-apical band; tibiae with two brown rings, anterior tibiae perforated with a large internal tympanum. Posterior femora long and narrow, adorned with two small brown spots near the apex; tibiae spotted with brown at base of the spines; these are brownish, the internal long and slender, the external a little stouter; metatarsi with apical half brown. Elytra long and narrow, covered with a fine pubescence; dorsal field with 4 feebly oblique and irregular veins, the second bearing 3

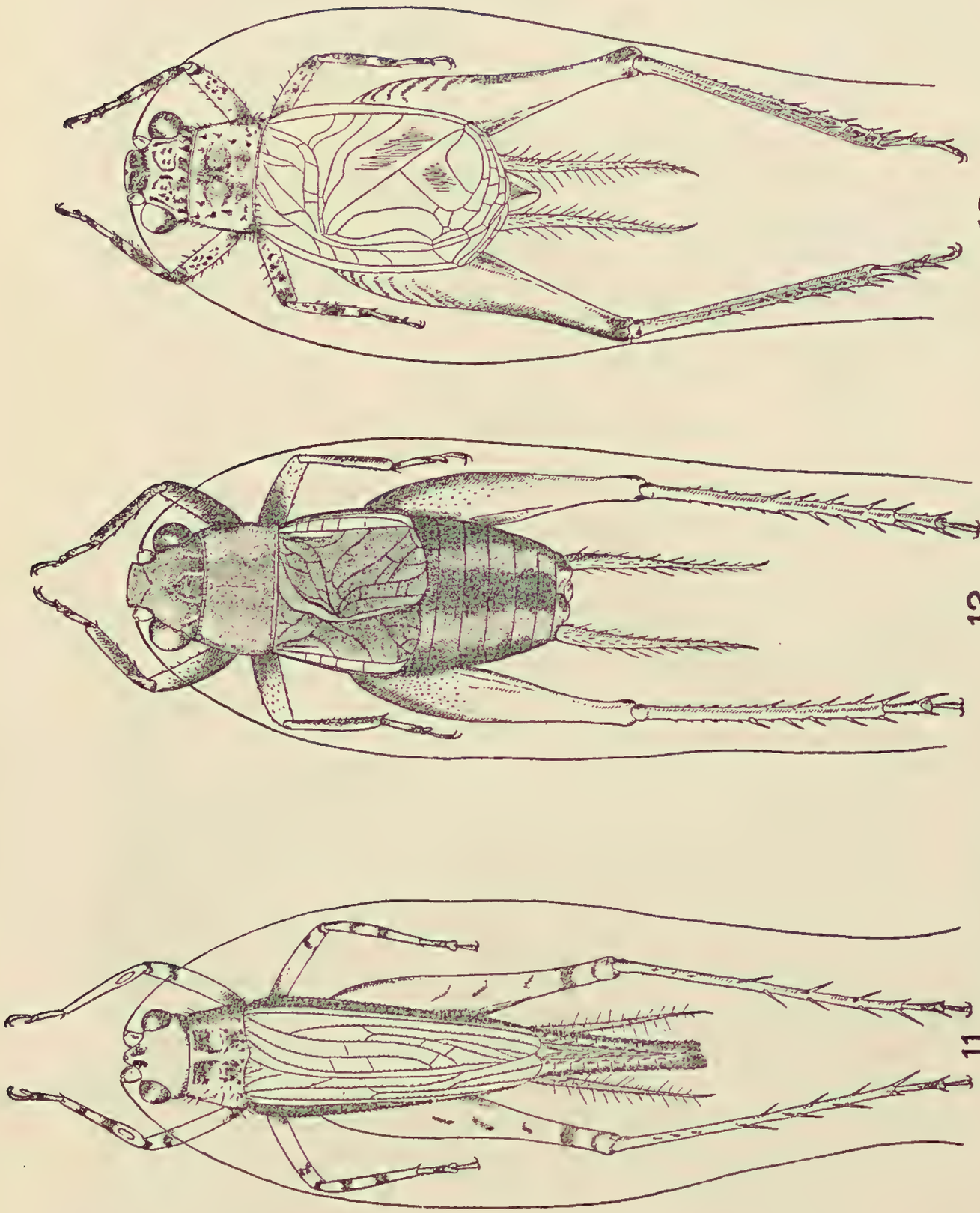


Fig. 11. *Amusurgus fascifrons* sp. n. ♂. Fig. 12. *Lebinthus bifasciatus* sp. n. ♂.
Fig. 13. *Salmanites obscurifrons* sp. n. ♂.

branches, the third and fourth unite at about the apical fourth; lateral field brown with 4 veins, one of which is incomplete. Wings longitudinally produced, with brown, pubescent anterior field.

Length of body 5·8 mm.; length with wings 10 mm.; post. fem. 5 mm.; elytra 5 mm.

Type: Queensland: Cairns Distr. (J. F. Illingworth), 1 ♂ (S.A.M.).

The type of this pretty little species is unique; it has very much the general shape and colour of *Metioche angusta,* from which it differs in the pubescent elytra, the forehead adorned with a brown transverse band, the longer posterior femora and the less regular elytral venation.

Gen. METIOCHODES Chopard.

The species of this genus present the same shape of the head and maxillary palpi as *Cyrtoxiphoides,* from which they differ markedly in the elytral venation which is similar in both sexes, the male with no distinct mirror. The genus is also close to *Amusurgus,* but differs in the shape of the head, which is in this last genus rounded above, not flattened as in *Cyrtoxiphoides;* and in the rounded eyes, which are not all lengthened. The elytral venation is more regular, the veins being usually straight and parallel.

KEY TO THE SPECIES OF *METIOCHODES.*

1. Anterior and medium tibiae with two small black spots near the base of internal face .. .. 1. *hackeri*
   Legs yellow, without spots 2
2. Elytra with 4 quite parallel veins; ovipositor with a very strong notch at base of the apical valves .. .. 2. *australicus*
   Elytra with 5 veins which are not regularly parallel, but slightly oblique, the two internal veins unite a little after the middle 3. *tindalei*

1. METIOCHODES HACKERI sp. n.

♀. Shape rather long; pale yellowish, pubescent. Head as wide as pronotum, a little flattened above; frontal rostrum as wide as first antennal segment. Antennae and palpi yellow; fourth segment of maxillary palpi a little shorter than third, fifth large, in the shape of a long triangle, somewhat obliquely truncated at apex. Eyes a little lengthened anteriorly and posteriorly; ocelli very small. Pronotum transverse, narrowing very feebly in front with sinuate posterior margin; disk convex, feebly pubescent; lateral lobes with anterior angle much rounded. Abdomen pale yellow; subgenital plate

wide at base, narrowing and rounded at apex. Legs rather long, pubescent. Anterior and medium tibiae with two small black spots near the base of internal face, the internal faces perforated with a large tympanum; median femora with also a small black spot near the apex, on internal face. Posterior femora long and narrow, without any design; tibiae with a small blackish spot near the base, armed with small, slender spines. Elytra with yellowish brown background, light veins, finely pubescent dorsal field with 5 veins which are feebly oblique, almost regularly spaced; the cubital vein is trifurcate near the base and the fourth and fifth veins (the most internal) are united about their apical third; the covered part of the left elytron is smooth, glabrous, transparent; lateral field transparent with 4 veins, three of wihch are long, straight, the fourth short and curved. Wings lengthily produced, with yellow, pubescent anterior field.

Length of body 6 mm.; length with wings 11·5 mm.; post. fem. 5·5 mm.; elytra 5·5 mm.

Type: Queensland: Dunk Is. (H. Hacker, Aug., 1927), 1 ♀ (Q.M.).

This species is quite recognizable by the small spots on the legs but it is also very different from the other species of *Metiochodes* in the shape of the maxillary palpi, the last segment of which is much larger than usual in the genus and triangular in shape, not at all securiform. In this respect, it somewhat resembles the genus *Amusurgus*, from which it differs in the almost parallel, not anastomosed elytral veins.

2. METIOCHODES AUSTRALICUS sp. n.

♀. Small, yellow, pubescent. Head slattened above; frontal rostrum with sides converging forwards, the apex much narrower than the first antennal segment; face short and wide, very pale yellow. Eyes a little lengthened anteriorly and posteriorly; ocelli very small. Antennae and palpi yellow; maxillary palpi with fourth segment shorter than third, fifth short, strongly widening at apex, slightly securiform in shape; third segment of the labial palpi also very wide. Pronotum transverse, with parallel sides, posterior margin rather strongly sinuated; lateral lobes with straight inferior margin, angles rounded. Abdomen yellow; subgenital plate wide, with rounded posterior margin. Ovipositor rather short with strongly denticulated apical valves, occupying almost half the total length. Legs yellow, the posterior ones wanting. Elytra long with parallel sides, yellow, pubescent, the covered part of the left elytron transparent; dorsal field with six almost longitudinal veins, the second one furcate near the apex; the fifth and sixth united about the middle of the internal margin; lateral field with 4 veins, one of which is not complete.

Wings somewhat longer than the elytra, their anterior margin with a row of small long brown spots.

Length of body 5·5 mm.; length with wings 11 mm.; ovipositor 2·2 mm.; elytra 6 mm.

Type: Queensland: Bathurst Head (Hale and Tindale, Jan., 1927), 1 ♀ (S.A.M.).

As the male of this species is unknown, it is difficult to ascertain whether it belongs to the genus *Metiochodes* or to *Cyrtoxiphoides*; yet the shape of the ovipositor suggests rather the first genus.

3. METIOCHODES TINDALEI sp. n.

Fig. 66.

Yellow, pubescent. Head with somewhat flattened vertex; frontal rostrum narrower than the first antennal segment. Face short and wide. Eyes a little lengthened anteriorly and posteriorly; ocelli very small. Antennae and palpi yellow; fourth segment of maxillary palpi much shorter than third, fifth short and wide, rather markedly securiform in shape, truncated at apex (fig. 66). Pronotum transverse, a little narrowing in front, with straight anterior margin, strongly sinuated, posterior subangulate; disk feebly flattened; lateral lobes a little high, with convex inferior margin and much rounded angles. Abdomen and cerci yellow; subgenital plate rather large, feebly notched at apex. Ovipositor rather long, curved, with apical valves notched at base, superior valves strongly crenellated (fig. 66). Legs yellow; anterior tibiae enlarged at base and perforated with a large oval tympanum on internal face. Posterior legs wanting. Elytra lengthened, parallel, pubescent; dorsal field with 4 longitudinal veins, almost straight and regularly spaced; transverse veinlets numerous, forming square areolae; the covered part of the left elytron is smooth and glabrous; lateral field with 3 veins. Wings rather lengthily produced, yellow, pubescent.

Length of body 7 mm.; length with wings 12 mm.; elytra 7 mm.; ovipositor 2·8 mm.

Type: Northern Territory: Groote Eylandt (N. B. Tindale), 1 ♀ (S.A.M.).

This species is remarkable in the shape of the ovipositor; it looks like a species of *Cyrtoxipha* but differs from that genus in the pubescent elytra; as the preceding, it might belong to *Cyrtoxiphoides* if the male elytron is provided with a distinct mirror.

FAMILY ENEOPTERIDAE.

The Eneopteridae are rather large Grylloids with depressed tarsi, posterior tibiae serrulated between the spines, and the head with a very wide frontal rostrum, the eyes being big, rounded and laterally projecting. The posterior tibiae are armed with 6 long apical spurs, of which the median is the longest, both on the internal and external faces.

KEY TO THE GENERA OF *ENEOPTERIDAE*.

1. Elytra extending to the apex of abdomen in both sexes, with well developed apical field .. .. *Cardiodactylus*
   Elytra shorter than abdomen, with almost no apical field 2
2. Frontal rostrum about one and a half times as wide as the first antennal segment .. .. *Eurepa*
   Frontal rostrum almost thrice as wide as the first antennal segment, which is very small 3
3. Elytra of male with complete mirror, almost extending to the apex of abdomen .. .. *Salmanites*
   Elytra of male very short, with indistinct mirror; elytra of female short .. .. *Lebinthus*

Gen. CARDIODACTYLUS Saussure, 1878.

The species of *Cardiodactylus* are large Grylloids with rather short and strong legs. The frontal rostrum is about as large as the first antennal segment; pronotum almost square; elytra long, with in the male a small mirror, often more or less divided by a wide reticulation; the wings are always caudate.

The species of this genus are known from the Malayan and Australian regions.

KEY TO THE SPECIES OF *CARDIODACTYLUS*.

1. Wings exceeding the elytra by half their length .. .. 4. *rufidulus*
   Wings exceeding the elytra by at most a third of their length, often much less 2
2. General shape short; colouration more uniform; ocelli larger 2. *gaimardi*
   General shape more lengthened; colouration usually brightly varied with brown and yellow; ocelli smaller 3
3. Anterior tibiae but feebly enlarged; ovipositor long and slender 1. *novae-guineae*
   Anterior tibiae strongly dilated near the base; ovipositor rather short 3. *canotus*

1. CARDIODACTYLUS NOVAE-GUINEAE (Haan.).

Gryllus (*Platydactylus*) *Novae-Guineae* Haan, 1842, Temminck, Verhandl. Orth., p. 233.

Rufo-testaceous; head with 4 light lines on the vertex; frontal rostrum a little wider than the first antennal segment. Elytra of male adorned with yellow spots; mirror narrow, acute backwards, divided by a transverse vein; its posterior part often reticulated; chords variable. Elytra of the female greyish or brownish with a yellowish spot in the middle; ovipositor straight, as long as the posterior femora.

Length of body 18–23 mm.; post. fem. 15–17·5 mm.; elytra 14–19 mm.; ovipositor 20–26 mm.

This large species is common in the Malayan islands; it has also been recorded from a few Australian localities.

Queensland: Cairns, Kuranda (S.A.M.); Stacey Is., South Cape (A.M.); Dunk. Is. (Q.M.).

Papua: Misima Island (Rev. R. J. Andrew), (S.A.M.).

2. CARDIODACTYLUS GAIMARDI (Serv.).

Platydactylus Gaimardi Serville, 1839, Ins. Orth., p. 366.

Very close to the preceding species but differing in the shorter ovipositor and the more regular elytral reticulation.

Australia: (Serville's type in the Paris Museum).

3. CARDIODACTYLUS CANOTUS Saussure.

Cardiodactylus canotus Saussure, 1878, Mem. Soc. Geneve, xxv, p. 522.

Differing from *novae-guineae* in the anterior tibiae being strongly swollen at base and in the shorter ovipositor.

Australia: (Saussure). The type, in the Paris Museum, comes from the Solomon Islands.

4. CARDIODACTYLUS RUFIDULUS Saussure.

Cardiodactylus rufidulus Saussure, 1878, Mem. Soc. Geneve, xxv, p. 523.

This species is also very similar to the preceding ones; its colouration is rather uniformly brown, the elytra with a yellow tinge at base with two brown spots; the wings are relatively longer than the other species. Australia: without exact locality (Saussure's type).

Gen. LEBINTHUS Stål, 1877.

The species of this genus are smaller than those of *Cardiodactylus* with abbreviated elytra in both sexes and wings completely abortive. They are known from the Philippine Islands and Malaya; one new species from Australia is described below.

LEBINTHUS BIFASCIATUS sp. n.

Fig. 12, 68.

♂. Small; brown with two light bands extending from the anterior margin of pronotum to the apex of elytra. Head as wide as pronotum in front; occiput shining brown, feebly shagreened, adorned with a rather weak W-shaped yellow line; frontal rostrum very wide, truncated, a little convex at apex. Face short, brown marbled with yellowish; facial shield convex but not swollen, furrowed in the middle, joining the vertex in a much rounded angle. Eyes rounded, rather projecting; ocelli very small, the anterior one at top of the frontal rostrum. Antennae very slender, with first segment small, brown. Palpi rather short with three last segments subequal in length; third and fourth segments with basal half brown, apex yellow; fifth segment widening a little at apex, yellow with base and apex brown. Pronotum transverse, with feebly concave anterior margin, posterior straight, narrowing feebly in front; disk convex, brownish with a wide yellowish irregular band on each side; anterior margin also pale yellowish; lateral lobes brown, with inferior margin ascending backwards. Abdomen testaceous brown with a darker median band; inferior part yellowish; supero-anal valve square, truncated at apex; subgenital plate large, wide at base, narrowing and a little truncated at apex. Genitalia wide, feebly notched at apex, with a round impress at base (fig. 68). Legs short and stout; anterior and middle femora brownish apex yellow; tibiae brown, vaguely annulated with yellow; anterior tibiae perforated with a large external tympanum; metatarsi yellow with base and apex brown, carinated beneath; second segment small, flattened brown, third yellow with apex brown. Posterior femora very wide, rufo-testaceous; tibiae armed with 4 spines on each margin, serrulated at base and with 1 denticle between the spines amongst a few long bristles; supero-external and infero-external spurs short, particularly the first one, the median much longer; internal spurs long, particularly the median, the superior a little longer than the inferior; metatarsi short, armed above with 3 external denticles and 1 internal denticle at apex, the apical spurs long; second segment brown, relatively long, a little depressed at apex; third segment slender, scarcely longer than the second, yellow with apex brown. Elytra glabrous, extending only to the middle of abdomen, blackish brown with

a yellow humeral band, truncated at apex; mirror rudimentary, composed of a triangular cell, at apex of the elytron, divided into three parts; diagonal vein long; chords a little curved, extending to the apex of the elytron; 2 veinlets unite the first chord and the mirror; 2 oblique veins only, of which one is long and the other, in the anal vein, is shorter; lateral field blackish, with 4 veins; Sc not divided.

♀. A little larger than the male; elytra reduced to very small lateral scales; light band of the pronotum prolonged on the metanotum. Subgenital plate small, a little notched at apex. Ovipositor very long, slender, with narrow, lanceolate apical valves.

Length of body ♂ 10 mm.; ♀ 13 mm.; pronot. ♂ 2 mm., ♀ 2·6 mm.; post. fem. ♂ 7·3 mm., ♀ 10 mm.; elytra ♂ 3·5 mm.; ovipositor 25 mm.

Types: Northern Territory: Daly River (H. Wesselman), 1 ♂; Port Darwin, 1 ♂ (S.A.M.); Mary River (G. F. Hill), 1 ♀ (Q.M.).

This species is very close to *L. leopoldi* Chop., from New Guinea; in the male, the anal knot is not swollen; the female is almost apterous and its ovipositor with narrower, more lengthened apical valves.

Gen. SALMANITES nov.

Frontal rostrum very wide; first segment of antennae very small. Posterior femora short and stout; tibiae serrulated, armed with 4 spines on each margin. Elytra of male extending almost to apex of abdomen, with a well developed mirror divided by a curved vein; apical field very short. Female unknown

SALMANITES OBSCURIFRONS sp. n.

Fig. 13, 69.

♂. Rather small, greyish brown, finely pubescent. Head as wide as pronotum, a little mottled with brown above; frontal rostrum short, very wide, truncated. Face blackish, shining, glabrous; top of the frontal shield with a narrow yellow line at the point where it joins the vertex. Eyes rather strongly projecting, rounded; lateral ocelli very small. Antennae very slender, yellowish, with first segment small, brown. Palpi blackish; fourth segment of maxillary palpi a little shorter than third, fifth rather large, triangular, obliquely truncated at apex. Pronotum transverse, narowing slightly in front, with anterior and posterior margins straight; disk feebly convex, greyish with a few small brown spots, very finely pubescent; lateral lobes black with narrow yellow band in the superior part; inferior margin ascending backwards, anterior angle 90°. Abdomen brown above, yellowish beneath; subgenital plate

long, very narrow at apex. Cerci moderately long, brownish with a dark band at internal face. Genitalia very long, almost tubular, notched at apex (fig. 69). Legs short, dark brown, a little annulated with yellowish, strongly pubescent. Anterior tibiae provided with a rather large oval tympanum at external face; metatarsi compressed, yellow with brown tip. Posterior femora short and stout; their external face yellowish with dark brown superior third; internal face a little striated with brown; tibiae armed with 4 spines on each margin; internal apical spurs long, chiefly the median one, the other two equal in length; externo-superior spur shorter than the inferior one, the median much the longest; metatarsi short, armed with 3 external and 1 internal denticle; apical spurs long, particularly the internal. Elytra wide, extending to the apex of abdomen, rounded at apex; colouration light grey with rufous veins; mirror rather large, very angulate in front, rounded behind, divided beneath the middle by a strongly arched vein; diagonal vein long; chords lengthened, the first almost straight, the second much sinuated, the third simply a little undulated; sutural vein quite distinct; 4 oblique veins of which 2 are long, sinuated, parallel, and 2 shorter in the angle of the anal vein; apical field very short with only two rows of irregular cells; lateral field dark brown; Sc bearing 6 branches. Wings very short.

Length of body 9 mm.; pronot. 2 mm.; post. fem. 12·5 mm.; elytra 6 mm.

Type: Queensland: Byfield near Yeppoon (A. Musgrave, Oct., 1924), 1 ♂ (A.M.).

Gen. EUREPA Walker, 1869 (p. 71).

(= *Salmania* Walker, 1869, p. 73).

The species of this genus have rather the aspect of a small *Cardiodactylus* with somewhat shortened elytra; in the female sex, the ovipositor is very long, sometimes exceedingly so. They are known from Australia and the Malay Archipelago.

KEY TO THE SPECIES OF *EUREPA*.

1. Frontal rostrum a little wider than the first antennal segment, truncate at apex, flat above; forehead feebly projecting 2

   Frontal rostrum twice as wide as the first antennal segment, rounded at apex, more or less convex above, the forehead in the shape of a projecting protuberance 3

2. Frontal rostrum with parallel margins; ovipositor as long as the body .. .. 1. *sordida*

   Frontal rostrum with margins rather strongly diverging backwards; ovipositor extremely long .. .. 2. *marginipennis*

3. Elytra of female very short, separated along the median line 6. *subaptera*
Elytra of female extending at least to the middle of abdomen, somewhat overlapping in the median line 4
4. *unicolor*

4. Head and pronotum wholly blackish; elytra brown with yellow veins
Face yellowish, more or less spotted with brown; head and pronotum above testaceous, more or less widely mottled with brown 5

5. Lateral lobes of pronotum yellowish; elytra of the female with parallel, longitudinal veins .. .. 3. *mjöbergi*
Lateral lobes of pronotum black; elytra of the female with oblique, somewhat irregular veins .. .. 5. *curvatifrons*

1. EUREPA SORDIDA (Walk.).

Salmania sordida Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 73.

Piestodactylus brevipennis Saussure, 1878, Mem. Soc. Geneve, xxv, p. 527.

A medium sized species; colour dark rufous, covered with a fulvous pubescence. In the male, the elytra extend almost to the apex of abdomen; the mirror is longer than wide, very acutely angulate in front, rounded posteriorly, divided before the middle by an angulate vein which is almost parallel to the anterior sides of the mirror; 2 oblique veins; first chord united to the angle of the mirror by a rather long veinlet, almost parallel to the diagonal vein; apical field short, rounded, with 4 sectors and a rather wide, regular reticulation. Elytra of the female short, extending to the fifth segment of abdomen; dorsal field rufous brown with a yellow humeral band, lateral field very dark. Wings a little longer than the elytra in the male, very short in the female. Ovipositor as long as body.

Length of body 19 mm.; pronot. 3 mm.; post. fem. 12 mm.; elytra ♂ 11 mm., ♀ 8 mm.; ovipositor 16–17 mm.

This species seems rather variable; the elytra of the male may be more or less spotted with brown in the anal field, between the chords and near the anterior angle of the mirror; the dividing vein of the mirror may be rather more curved than angulate as in the type; the length varies from 16 to 19 mm.

North Australia: (Walker's type; Saussure's type of *brevipennis*).

Queensland: Almaden, Chillagoe Distr. (W. D. Campbell, v., 1926), (A.M.); Endeavour River (Paris Mus.); Inkerman, near Townsville (W. Stalker, 1908), (Br. M.); Magnetic Island, Kuranda (S.A.M.).

Northern Territory: Darwin, Koolpinya (S.A.M.).

South Australia: Palmiston, Mt. Bryan (S.A.M.).

2. EUREPA MARGINIPENNIS (White).

Acheta (?) *marginipennis* White, 1841, Grey, Journ. Exp. Austr., ii, p. 467.

Piestodactylus longicauda Saussure, 1878, Mem. Soc. Geneve, xxv, p. 529.

Very close to the preceding but smaller; in the male the elytra extend to the abdominal extremity, their apices rounded; mirror rather large, as long as wide, anterior angle a little obtuse, posterior margin rounded, divided in the middle by a curved vein; diagonal vein rather long, straight; chords long, feebly curved; 3 oblique veins, two of which are long, sinuate, almost parallel, and the third very short in the angle of the anal vein; apical field rather short with 3 sectors and a wide reticulation; lateral field with 11 rather regularly spaced veins, of which 8 are branches of Sc. Wings not longer than the elytra. Ovipositor of the female about twice as long as the body.

Length of body ♂ 10–13·5 mm., ♀ 13–16 mm.; post. fem. 9–12 mm.; elytra ♂ 7·5–9·5 mm.; ♀ 8–8·5 mm.; ovipositor 20–32 mm.

Western Australia: Lawlor (A.M.); Busselton (S.A.M.); King George's Sound (Walker), (Br. M.).

South Australia: Kangaroo Is., Riverton, Yeelanna, Penong, Mt. Barker, Karoonda to Peebinga, Owieandana, Buckleboo, Murat Bay, Eyre Pen., Mt. Lofty Ranges, Parrakie, Tanunda, Adelaide, Darkes Peak (S.A.M.); Kingscote, K.I. (A.M.).

New South Wales: Binnaway (A.M.).

Victoria (Paris Museum).

3. EUREPA MJÖBERGI Chopard.

Eurepa mjöbergi Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 44, fig. 90–94.

Very close to the preceding from which it differs in the wider frontal rostrum, the yellow lateral lobes of pronotum and the shorter ovipositor.

Western Australia: Derby, Kimberley Distr. (types in the Stockholm Mus.).

4. EUREPA UNICOLOR sp. n.

Fig. 70.

♂. Rather large species, colouration a uniform dark brown, very finely pubescent. Head as wide as pronotum; vertex sloping and even a little excavated at base of rostrum; this is twice as wide as the first antennal segment, with parallel margins, flat above, rounded apex. Face blackish brown, smooth; facial shield forming a projecting, finely furrowed protuberance. Eyes rounded,

feebly projecting laterally; ocelli small, the anterior one much before the apex of the rostrum. Antennae and palpi brown; third and fourth segments of the maxillary palpi equal in length, fifth a little longer, scarcely enlarged at apex, with superior margin little concave. Pronotum a little wider than long, with slightly concave anterior margin, posterior straight. Disk feebly convex, a little irregular; lateral lobes concolorous, with inferior margin ascending backwards. Abdomen dark brown, feebly pubescent; supero-anal valve a little truncated at apex; subgenital plate rather long, strongly narrowing towards the apex which is slightly truncated. Cerci long; lighter than the body. Legs rather short. Genitalia less tubular than those of *sordida*, more angulately notched at apex (fig. 70). Legs rather short, of a somewhat rufous brown colouration. Anterior tibiae perforated on external face with an oval tympanum. Posterior femora thick, unicolorous; tibiae armed with 4 spines on each margin, strongly serrulate at base and between the spines; apical spurs compressed, the median one the longest on each side; metatarsi rather short, a little compressed, armed with 4–5 external, 2 internal denticles. Elytra extending almost to the apex of abdomen, brown with lighter veins; apex rounded; mirror longer than wide, subangulate in front, rounded behind, divided in the middle by a curved vein; diagonal vein short; chords rather strongly curved, parallel; 4 oblique veins; apical field rather large, with 5 sectors and a rather close, regular reticulation; lateral field concolourous with 5 precostal veins and 6 branches of the subcostal. Wings very short.

♀. Similar to the male in general shape and colouration. Elytra extending to the apex of the fifth abdominal tergite, rounded at apex; veins yellow on a brown background, slightly oblique, rather regularly spaced; Cu bearing 3 branches; transverse veinlets forming rather regular, lengthened areolae, except at base where they are very close; Sc bearing 3 branches. Ovipositor very long, with narrow, lanceolate apical valves.

Length of body ♂ 17 mm., ♀ 19 mm.; pronot. ♂ 3·5 mm., ♀ 3·8 mm.; post. fem. ♂ 12·5 mm., ♀ 14 mm.; elytra ♂ 10 mm., ♀ 8 mm.; ovipositor 42 mm.

Types: South Australia: Ooldea (A. M. Lea), 1 ♂, 1 ♀ (S.A.M.).

This species is relatively large, of a dark brown, uniform colouration with the veins of elytra lighter; the frontal shield is strongly swollen, the superior face of the frontal rostrum flattened, the ovipositor of the female is extremely long.

Besides the 3 males and 4 females from the type locality, the South Australian Museum collection contains a female from Kingoonya, S.A. (R. Harvey).

Western Australia: Lawlers (W. O. Mansbridge), (Br. M.).

5. EUREPA CURVATIFRONS sp. n.

♀. Colouration yellowish grey with brown spots; finely pubescent. Head a little wider than pronotum in front, feebly flattened above; occiput adorned with 5 short brown bands; frontal rostrum about twice as wide as first antennal segment, with parallel margins, apex rounded. Face yellowish, feebly marbled with brown; facial shield markedly swollen, finely furrowed in the middle; cheeks yellowish with a brown spot behind the eye. Eyes a little lengthened dorsally and ventrally, rounded, protruding; ocelli very small, the anterior a little before the apex of the rostrum. Antennae slender, brownish, lighter at base. Palpi short, yellowish, spotted with brown; the three last segments of the maxillary palpi subequal in length, the last rather markedly enlarged at apex, with feebly concave superior margin, apex a little convex, bordered with brown. Pronotum transverse; narrowing a little in front, with almost straight anterior and posterior margins; disk very slightly convex, yellowish marbled and spotted with brown, especially about the middle; lateral lobes blackish with a small yellow spot in the anterior angle, inferior margin ascending backwards. Abdomen yellow beneath, yellowish spotted with brown above with a median brown band. Ovipositor long and slender, with apical valves oval, lanceolate, scarcely wider than the stem. Legs yellowish spotted with brown, the posterior ones wanting. Elytra extending no farther than the apex of the third abdominal tergite, yellowish with darker, thick veins, the two cubital veins being furcate; transverse veinlets irregular; lateral field blackish with a light band between Sc and M; Sc bearing 2 branches; 3 precostal veins of which the third lies along the margin.

Length of body 12 mm.; pronot. 2·3 mm.; ovipositor 23 mm.; elytra 4 mm.

Type: South Australia, 1 ♀ (S.A.M.)

This species is close to *mjöbergi* but with the lateral lobes of pronotum darker, less regular elytral venation and much longer ovipositor.

6. EUREPA SUBAPTERA Chopard.

Eurepa subaptera Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 45, fig. 95–96.

This species differs from all the others of the genus in its short elytra which are separated on the median line.

Known only from the type specimen in the Stockholm Museum, without exact locality.

FAMILY ITARIDAE.

The insects of this family differ from the preceding in the smaller head with narrow frontal rostrum; in the male, the elytra are very wide with numerous oblique veins. They are very characteristic of the Malay region with a few African species and one in Australia.

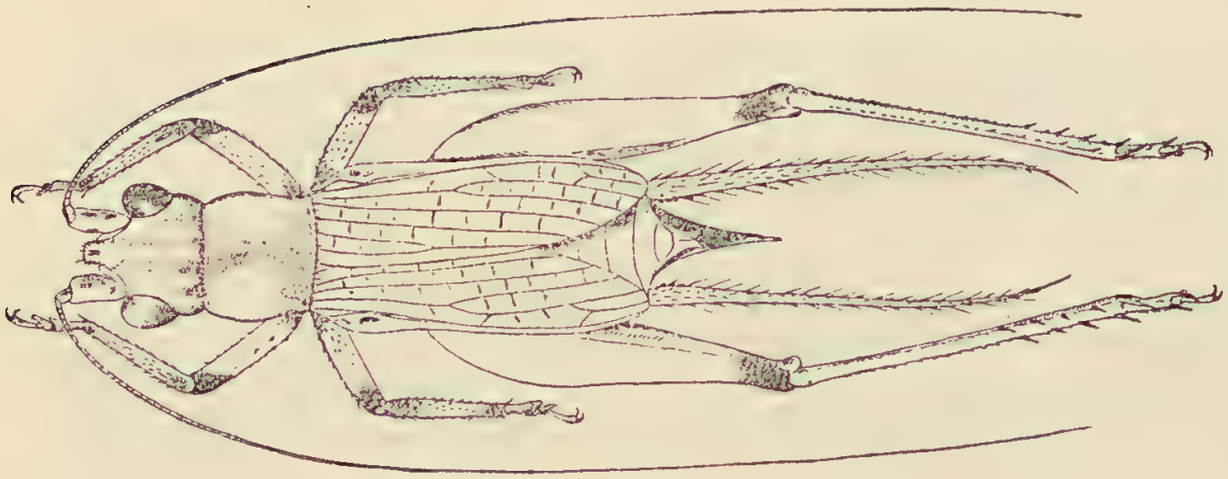
Gen. TREMELLIA Stål, 1877.

This genus has been placed amongst the Phalangopsidae because of the hardly depressed second tarsal segment but most of the characters and especially the elytral venation of the male are more characteristic of the Itaridae.

TREMELLIA AUSTRALIS sp. n.

Fig. 14, 71.

Testaceous brown with a few darker spots. Head a little wider than the pronotum in front; vertex sloping, ending in a short rostrum, wide at base with strongly converging margins, narrow feebly rounded apex. Antennal sockets with a strong angular prominence on internal margin. Face lengthened, yellowish with brown superior part, the two colours separated by a straight line joining the inferior margins of the antennal sockets; the brown part is divided by a fine median yellow band; cheeks with a brown arched band behind the eye. Eyes rounded, markedly projecting; ocelli very small, disposed as a triangle. Antennae slender, annulated with yellow and brown. Palpi yellow; fourth segment of the maxillary palpi much shorter than third, fifth long and narrow, triangular. Pronotum a little wider than long, with anterior margin convex, a little notched in the middle; posterior margin straight; disk weakly convex, irregular; lateral lobes adorned with two brown bands, the superior one the widest. Abdomen brownish; subgenital plate triangular. Genitalia short and wide, deeply notched at apex, each lobe ending in a small tooth (fig. 71). Legs long and slender, annulated with brown. Anterior tibiae with internal foramen only; anterior metatarsi long, yellow with brown top, second and third segments blackish, the third very long and slender. Median legs a little shorter than anterior. Posterior femora feebly dilated at base, with a very long filiform apical part, adorned on external face with an oblique brown band; tibiae very long and slender, armed with 2 external and 3 internal short, slender, yellow spines; serrulation reduced to a few very small denticles on the external margin; external apical spurs very short, median and particularly supero-internal ones very long; metatarsi very long, compressed; second seg-



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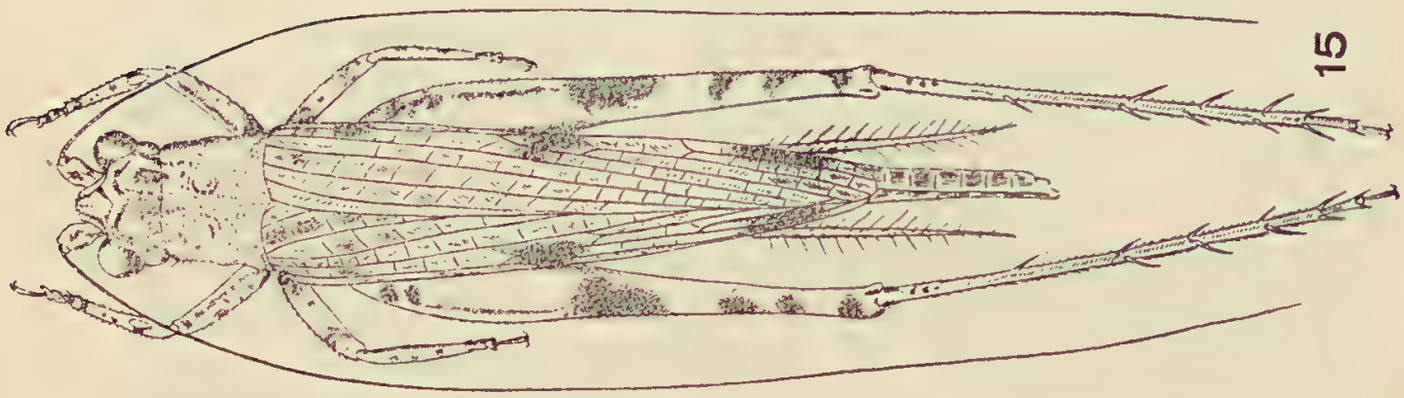

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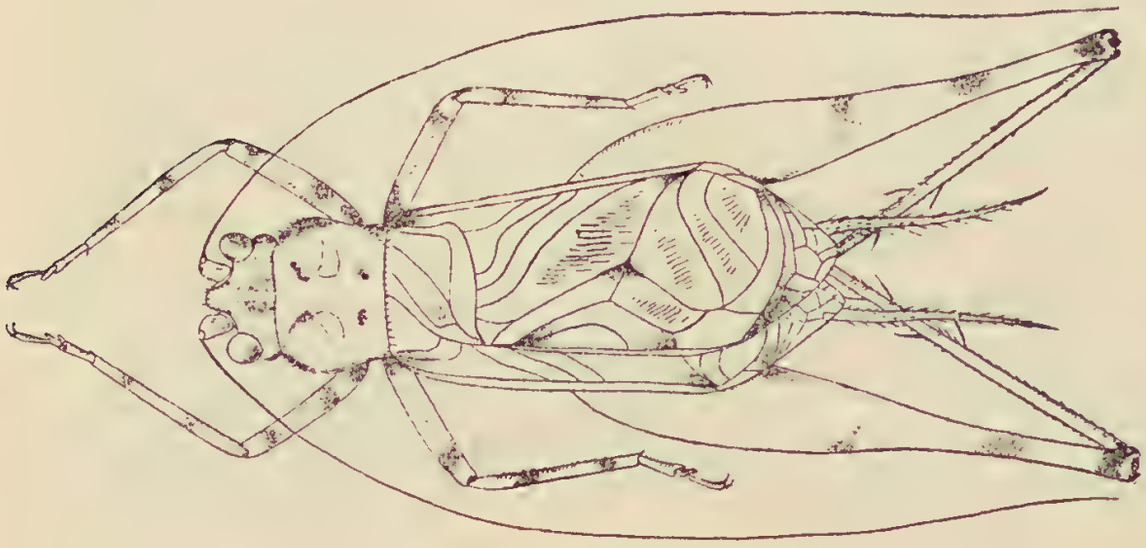

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Fig. 14. *Tremellia australis* sp. n. ♂. Fig. 15. *Aphonoides hackeri* sp. n. ♂. Fig. 16. *Adenopterus norfolkensis* sp. n. ♂.

ment small, depressed, third long and slender. Elytra extending a little beyond the apex of abdomen, a little widening backwards, testaceous brown with a few brown spots; mirror as long as wide, angulate in front, rounded behind, divided by two parallel veins, the median part narrower than the other two; diagonal vein and chords rather short, the first chord subangulate, united to the mirror by two veinlets; 4 oblique veins, nearly parallel; apical field short with 3 sectors and a very wide reticulation; lateral field dark brown in its superior part; Sc with numerous branches; the space between Sc and R with about 10 parallel small veins. Wings not longer than elytra.

Length of body 10·5 mm.; pronot. 2 mm.; post. fem. 13 mm.; elytra 9 mm.

Type: Queensland: Cairns Distr. (A. M. Lea), 1 ♂ (S.A.M.).

This species is easy to recognize as it is the only Australian Grylloid with mirror divided by two veins. Besides the type specimen I have seen two other males of this species.

Queensland (F. P. Dodd), 1 ♂ (Br. M.).

Papua: Misima Is., Louisiade Arch. (Rev. R. J. Andrew), 1 ♂ (S.A.M.).

FAMILY PODOSCIRTIDAE.

This family contains a great number of species which are rather different in general shape but always have the posterior tibiae serrulated between the spines, their external apical spurs being very short and the metatarsi short. The Australian genera may be distinguished with the following key.

KEY TO THE GENERA OF *PODOSCIRTIDAE*.

1. Elytral venation different in both sexes 2
   Elytral venation similar in both sexes 5
2. Elytra of male with a perfect mirror 3
   Elytral mirror of the male incomplete 4
3. Body, legs and antennae covered with an abundant pubescence; frontal rostrum very narrow, with converging sides; first segment of antennae somewhat depressed; last segment of maxillary palpi securiform .. .. *Dolichogryllus*
   Pubescence short and not so abundant; first segment of antennae not depressed, frontal rostrum wider .. .. *Madasumma*
4. Elytra of male with, in addition to the anal vein, the diagonal, the chords and an incomplete mirror (fig. 77, 78); veins rather irregular and oblique; posterior femora without spines .. .. *Hemiphonus*
   Elytra of male without any trace of the mirror; veins very regular and parallel; posterior femora armed with a very strong spine on the infero-external margin .. .. *Hemiphonoides*

5. Body of very slender shape; head flattened above; ovipositor acute without apical valves .. .. *Euscyrtus*

   Body more robust, with convex sides; ovipositor with well defined apical valves 6

6. Anterior tibiae perforated with two tympana; elytra of male with a large glandular pit .. .. *Adenelytron*

   External tympanum of the anterior tibiae obliterated; elytra of male without glandular pit .. .. *Aphonoides*

Gen. MADASUMMA Walker, 1869.

The males in the species of this genus have a perfect elytral tympanum with a large mirror, divided by a straight vein; 5 to 7 oblique veins; lateral field of the elytra with numerous branches of the Sc. The pronotum is rounded above; the legs are moderately long, more or less pubescent; anterior tibiae furrowed above, with two foramina, the internal often slit-like. The genitalia show very good specific characters in the male sex. Unfortunately, most of the Australian species are known only from the female sex.

The species of *Madasumma* are numerous in the Indo-Malayan region and in Madagascar; only a few have been recorded from Australia and there are some certainly remaining to be discovered.

KEY TO THE SPECIES OF *MADASUMMA* (FEMALES).

1. Face shining with a wide black band, cut by three transverse yellow lines .. .. 1. *australis*

   Face testaceous or brownish without black band 2

2. Ocelli very big, contiguous; size large, colouration dark brown 3. *ocellata*

   Ocelli smaller, more or less separated 3

3. External tympanum of the anterior tibiae reduced to a small round opening; colouration dark brown .. .. 4. *obscura*

   External tympanum of the anterior tibiae oval 4

4. Last segment of maxillary palpi long, triangular, slightly enlarged at apex (fig. 72) 5

   Last segment of maxillary palpi rather wide, somewhat securiform (fig. 73) 6

5. Frontal rostrum almost as wide as first antennal segment, which is small, scarcely longer than wide .. .. 5. *affinis*

   Frontal rostrum very narrow at apex .. .. 2. *aperta*

6. Posterior tibiae not serrated .. .. 9. *continua*

   Posterior tibiae serrated at base and between the spines 7

7. Venation quite irregular, the principal veins hardly distinct from the reticulation (fig. 74) .. .. 8. *reticulatus*

Venation more regular, the principal veins well separated from the reticulation 8

8. Venation quite regular with only one row of cells between the principal veins; 7 or 9 oblique sectors in the dorsal field (fig. 75); pubescence very short and weak .. .. 6. *planiceps*

Venation not so regular with two rows of cells between the principal veins; 6 sectors in the dorsal field (fig. 76); pubescence longer 7. *hornensis*

1. MADASUMMA AUSTRALIS (Walk.).

Platydactylus australis Walker, 1869, Cat. Derm. Salt. Br. M., i, p. 87.

This species was described from the male sex; from Walker's description the following features help to characterize it:

Head as broad as the prothorax, prominent between the sockets, forepart shining, with a broad black band, including three transverse yellow lines. Fore-wings testaceous-cinereous, extending to the tip of the abdomen; space towards the tip reticulated; subcostal space with twelve oblique slightly curved veins, those towards the base very near each other, the twelfth forked. Hind-wings extending much beyond the fore-wings. Length of the body 12 lines.

Australia: (type in the British Museum).

2. MADASUMMA APERTA (Sauss., 1878).

Calyptotrypus apertus Saussure, 1878, Mem. Soc. Geneve, xxv, p. 576; Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 49, fig. 101.

♀. Large species of a fulvo-testaceous colour; frontal rostrum very narrow between the antennae; ocelli rather large, separated by a space equal to their own width; last segment of the maxillary palpi twice as long as fourth, enlarged and rounded at top. Elytra with 10–11 oblique veins.

Length with elytra 30 mm.; post. fem. 14 mm.; elytra 25 mm.; ovipositor 12 mm.

Queensland: Rockhampton (Saussure's type in Brunner's collection, Wien. Mus.); Alice River (Stockholm Mus.).

3. MADASUMMA OCELLATA sp. n.

Large species of a pale brownish colouration; finely pubescent. Head as wide as pronotum, testaceous above with a dainty brownish network W-like and a spot of the same colour; base of the rostrum in front of the antennae

darkened; frontal rostrum narrow, with almost parallel margins; face short, yellow with 3 narrow transverse bands, the first along the antennal sockets, the second in the middle of the facial shield, the third along the superior margin of the clypeus and of the mandibles; clypeus with almost straight superior margin, the superior part (postclypeus) very narrow. Eyes rounded, rather projecting forwards; ocelli very big, contiguous. Antennae brown. Palpi yellowish; fourth segment of the maxillary palpi shorter than third, fifth long, feebly enlarged at apex. Pronotum one and a half times as wide as long, with feebly concave anterior margin, posterior convex; disk almost flat, a little embossed and varied with brown; lateral lobes rather high, concolorous, with straight inferior margin, rounded angles. Abdomen brown; subgenital plate widely notched with rounded lobes. Ovipositor rather long, straight; apical valves oval, finely granulate, inferior margin with 5 rounded teeth. Anterior legs wanting. Middle tibiae testaceous with 5 longitudinal brown lines at external face; tibiae thick, a little flattened above. Posterior tibiae striated with brown on the external face; tibiae armed with 5 external, 6 internal spines, serrulated at base and between the spines; apical spurs short, the superointernal one a little longer than half the metatarsus; the latter is short, armed with 2 apical denticles and 2 on the external margin; apical spurs long, the internal equalling the long tibial spur. Elytra brown, finely pubescent, with veins a little darker than the background; dorsal field with 6 sectors rather regularly spaced, a little oblique; reticulation rather regular except towards the base where there are often two rows of very irregular cells between the veins; Sc with 10 branches. Wings a little longer than the elytra.

Length of body 21 mm.; length with wings 40 mm.; pronot. 4 mm.; post. fem. 15·5 mm.; elytra 31 mm.; ovipositor 17·5 mm.

Type: Queensland: Chillagoe Distr., Almaden (W. D. Campbell), 1 ♀ (S.A.M.).

This large species is close to the preceding but with the frontal rostrum less narrow at apex, and with very big, contiguous ocelli.

4. MADASUMMA OBSCURA Chop. 1925.

Madasumma obscura Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 48, fig. 100.

♀. Long and narrow, dark brown. Head adorned with a brown band on the occiput prolonged on to the vertex; frontal rostrum flat, rather narrow at apex; fifth segment of maxillary palpi rather long, slightly enlarged. Anterior tibiae flattened above, a long furrow on their internal face and a rather large, oval tympanum; on the external face, the tympanum is obliterated, reduced to

a very small round opening. Elytra brown with dark veins, bordered with rufous, with two feebly marked light spots along the edge. Wings extending very little beyond the elytra.

Length of body 16 mm.; length with wings 22 mm.; pronot. 3 mm.; elytra 17 mm.

This species differs from the other species of the genus in its colouration and by the external tympanum of the anterior tibiae which is hardly indicated.

Western Australia: Laura (type in the Stockholm Mus.).

5. MADASUMMA AFFINIS Chop. 1925.

Madasumma affinis Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 47, fig. 97.

Testaceous, feebly pubescent; face rufo-testaceous; fifth segment of maxillary palpi hardly dilated at apex. Ocelli big in both sexes, but not so much as in *ocellata*. Elytra of male light brown with a yellow humeral band; 8 oblique veins; mirror almost one and a half times as long as wide; elytra of female of the same colour, with 10 very regular, oblique sectors.

Length of body 19 mm.; length with wings 29 mm.; pronot. 3·5 mm.; post. fem. 12·5 mm.; elytra 20 mm.; ovipositor 11·5 mm.

This species seems close to *australis* Walk., but the face does not show a black band.

Queensland: Stewart River, Burdekin Distr. (S.A.M.); Mitchell River, Almaden, Chillagoe Distr., Belyanda River (A.M.); Alice River (types); Cooktown (Stockholm Mus.); Endeavour River (Paris Museum).

Northern Territory: Darwin (S.A.M.); Groote Eylandt (Br. M.).

Western Australia: North West. Aust. (A.M.); Broome, Derby, Kimberley Distr., Noonkanbah (Stockholm Mus.).

6. MADASUMMA PLANICEPS (Sauss.).

Calyptotrypus planiceps Saussure, 1878, Mem. Soc. Geneve, xxv, p. 572, pl. 18 (lxii), fig. 9.

Yellowish; head small, flattened; frontal rostrum narrow; last segment of maxillary palpi somewhat enlarged at apex. Pronotum flattened above, narrowing in front; insertion of lateral lobes almost angular.

Length of body 26 mm.; elytra 21 mm.; post. fem. 11·5 mm.; ovipositor 13 mm.

This species rather differs from the preceding in the shape of the pronotum, which is almost that of the Indo-Malay genus *Calyptotrypus* with which it constitutes a distinct link.

Queensland: Cape Yorke (Saussure's type in Brunner's collection); Cairns Distr. (A. M. Lea), (S.A.M.).

Northern Territory: Darwin (G. F. Hill), (S.A.M.).

7. MADASUMMA HORNENSIS sp. n.

Rather large, long, testaceous, a little pubescent. Head with 6 whitish lines; frontal rostrum very narrow between the antennae, almost triangular; face short, yellow. Eyes rounded; ocelli rather big, the anterior one in the middle of the rostrum. Antennae and palpi testaceous; fourth segment of the maxillary palpi much shorter than third, fifth feebly securiform. Pronotum with anterior and posterior margins spotted with small, brown, setigerous points; anterior margin straight, posterior one subangular, disk almost flat, covered with a white pubescence; insertion of the lateral lobes almost angulate; these lobes are concolorous with straight inferior margin. Abdomen yellowish; subgenital plate transverse with straight posterior margin. Ovipositor straight, rather long; apical valves with 6 projecting, concentric lines. Legs of the same colour as the body, covered with an abundant white pubescence. Anterior tibiae thick, perforated with two oval tympana, the internal the larger. Elytra long, narrow, testaceous with 5 brown spots on the edge; 5 branches of the cubital vein, rather distant from one another, with between them two rows of irregular cells; lateral field a little lighter than the dorsal field; Sc bearing 6 branches. Wings much exceeding the elytra.

Length of body 19 mm.; length with wings 29 mm.; post. fem. 11 mm.; elytra 19·5 mm.; ovipositor 13·5 mm.

Type: Horn Island, Torres Straits, 1 ♀ (S.A.M.).

This species differs from *planiceps* in that the elytral venation is much less close and less regular; in *planiceps* between the branches of the cubital vein there is only one row of cells.

8. MADASUMMA RETICULATUS sp. n.

Very close to the preceding; general colouration a little more rufous. Pronotum with insertion of the lateral lobes a little more angular; disk with a narrow yellow band on each side (the continuation of a similar band on the head behind each eye); lateral lobes with inferior margin feebly sinuated. Subgenital plate with a wide angular notch; ovipositor a little shorter and stouter, the apical valves similar to those in *hornensis*. Elytra with venation even less clear than the preceding, the principal veins being feebly visible in the middle of a wide and irregular reticulation; 6 branches to the cubital vein, the two first of which are united at base; the cells between the veins are very

irregular, but most of them are large and disposed on a single row; Sc with 6 branches.

Length of body 18 mm.; length with wings 28 mm.; elytra 20·5 mm.; ovipositor 12 mm.

Type: South Australia: Karoonda, 1 ♀ (S.A.M.).

9. MADASUMMA CONTINUA (Walk.).

Platydactylus continuus Walker, 1869, Cat. Derm. Salt. Br. Mus., i, p. 87.

The description of this species which I have not seen is as follows:

"*Female.* Testaceous, slender, pubescent. Head slightly elongate, very prominent between the sockets of the antennae, three blackish stripes on the vertex, united in front. Eyes dark reddish, elongated, slightly prominent. Third segment of the palpi clavate, excavated beneath, longer than the second. Antennae blackish, pale and with blackish rings towards the base; first segment slightly dilated on the inner side. Prothorax longer than broad, slightly narrower in front, with a few black speckles and with two black stripes; sides straight. Cerci a little longer than the oviduct, which is straight and has a black tip and is as long as the abdomen. Legs rather short and stout, speckled with brown; hind tibiae setose and not serrated on each side, four spines on one side alternate with the same number on the other. Fore-wings reticulated, extending much beyond the abdomen; transverse sectors oblique; a brown stripe along the scapular vein including various small pale marks, subcostal space cinereous, with irregular transverse sectors and with ten very slanting branches of the mediastinal vein, the tenth forked. Hind wings extending much beyond the fore-wings. Length of body 9 lines."

From this description, it seems that this species must be rather close to the preceding; the denticulation of the posterior tibiae is particularly weak and this character could help to recognize the species, the type of which is not in the British Museum and is probably lost.

North Australia: In Mr. Saunder's collection.

Gen. DOLICHOGRYLLUS Bolivar, 1910.

DOLICHOGRYLLUS BRUNNEOVARIEGATUS sp. n.

Large species, greyish, varied with dark brown, pubescent. Head dark brown above with two narrow yellow lines behind the eyes and two other similar, but less visible lines near the middle; frontal rostrum depressed at base, very narrow at apex. Face yellowish; superior margin of the clypeus darkened. Eyes almost triangular in shape; ocelli small, the anterior one

scarcely visible in the bottom of a gutter in the middle of the rostrum. Antennae brown annulated with yellow; first segment large, depressed, brown above with a wide yellow longitudinal band, yellow beneath with brown base and apex. Palpi yellowish, brown above; fourth segment of maxillary palpi short, fifth longer than third, subsecuriform, rather wide with rounded apical angle. Pronotum transverse with convex posterior margin; disk flat with two deep impressions forwards, the median line impressed, and with two big tuberculiform protuberances on the shoulders; colouration blackish brown with a fine silvery pubescence and a lateral yellow line following the one which is on the head behind the eyes; lateral lobes concolourous with inferior margin slightly convex, anterior angle right, slightly rounded, posterior angle completely obliterated. Abdomen brown; subgenital plate widely notched, almost in a half circle, with rounded lobes. Cerci marbled with brown and yellow. Ovipositor long, rather stout, a little curved upwards, with apical valves lengthily oval, finely wrinkled and with 4 concentrical ridges; their inferior margin has only the basal tooth. Legs short, pubescent, blackish spotted with yellow; anterior tibiae stout, almost quadrangular, with external tympanum rather small, almost round, internal one larger, oval with anterior margin somewhat overlapping; metatarsi very short, second segment of tarsi flattened, very wide. Posterior femora rather slender, blackish striated with yellow on external face and the inferior part yellow almost to the apex; tibiae blackish with 5 spines on each margin, denticulate at base and between the spines; metatarsi short, armed with 2 external, 1 internal denticle, the apical spurs rather long, subequal in length. Elytra long and rather narrow, finely pubescent, dorsal field greyish with yellow veins, with numerous small brown spots in the areolae and 4 large spots behind the branches of the cubital vein; transverse veinlets somewhat projecting but rather obsolete and irregular; 6 branches to Cu; lateral field blackish; Sc bearing 8 branches. Wings greyish, extending little beyond the elytra.

Length of body 20 mm.; length with wings 33 mm.; pronot. 3·8 mm.; post. fem. 13 mm.; elytra 23·5 mm.; ovipositor 15·5 mm.

Type: South Australia: Marree (L. Reece), 1 ♀ (S.A.M.).

A second female of the same species comes from Emerald (T. R. Smith); it is larger and a little darker, there is a wide black band on its face extending to the cheeks. (Length of body 23 mm.; length with wings 39 mm.; post. fem. 14 mm.; elytra 27·5 mm.; ovipositor 17 mm.).

The genus *Dolichogryllus* was erected for an African species; it is very close to *Madasumma* and probably has the same wide geographical distribution in the Old World.

Gen. HEMIPHONUS Saussure, 1878.

With the genus *Hemiphonus* we get to those species in which the elytral venation differs little in the two sexes, the tympanum of the male being more or less incomplete; the general shape is long and rather slender. The described species are from Australia and Oceania.

KEY TO THE SPECIES OF *HEMIPHONUS* (MALES).

1. Mirror completely absent, the elytral venation consisting only of the anal vein and the oblique veins (fig. 77) 2
   Mirror distinct although partly lost in the venation (fig. 78) .. 3
2. Subgenital plate acute at apex .. .. 1. *vittatus*
   Subgenital plate rounded at apex .. .. 2. *vicinus*
3. Face smooth, yellowish 5
   Face blackish with yellow tubercles 4
4. Frontal rostrum subtruncate at apex; facial callosities weak. 6. *callosifrons*
   Frontal rostrum subspinose at apex; facial callosities very strong 7. *tuberculifrons*
5. Lateral lobes of pronotum yellowish 6
   Lateral lobes of pronotum blackish .. .. 3. *frontalis*
6. Frontal rostrum with feebly converging sides; head without long hairs .. .. 4. *gracilis*
   Frontal rostrum very narrow at apex; occiput provided with a tuft of very long hairs .. .. 5. *villosiceps*

1. HEMIPHONUS VITTATUS Saussure, 1878.

Hemiphonus vittatus Saussure, 1878, Mem. Soc. Geneve, xxv, p. 621, pl. 18 (lxvii), fig. 1–6.

Fig. 77, 80.

Testaceous with a dark lateral band extending from the apex of vertex to the extremity of the elytra. Frontal rostrum very narrow in front, almost angulate. Elytral venation of male rather variable but never with a distinct mirror; on the contrary, the anal vein and the oblique veins are more or less perfectly distinct. Subgenital plate very long, ending in a point. In the female, the ovipositor is rather short and stout, its apical valves black, strongly denticulated.

North Australia: (Saussure's type).

Queensland: Brisbane (H. Hacker, ii, 1915), Rockhampton (A. M. Lea), (S.A.M.).

Polynesia: Viti Island (Saussure).

2. HEMIPHONUS VICINUS sp. n.

Fig. 81.

♂. In shape and general aspect close to the preceding, with very neat dark lateral bands; head almost completely blackish above. Frontal rostrum very narrow, subangulate at apex. Pronotum with very neat blackish bands which are a little undulated and lined with a whitish external line. Subgenital plate of male long but slightly rounded at apex; genitalia of the same type as *vittatus* but with the superior piece a little more denticulated, the left inferior piece short (fig. 81). Elytra with anal vein markedly sinuate but not extending to the internal edge; no indication of a mirror; 5 oblique veins.

♀. Subgenital plate strongly notched at apex with slightly rounded lobes. Ovipositor straight, thick, with oval apical valves; their external face is striated and with 4 ridges in the inferior portion, apex rounded.

Length of body ♂ 18·5 mm., ♀ 23 mm.; length with wings ♂ 27·5 mm., ♀ 32 mm.; post. fem. ♂ 12 mm., ♀ 14 mm.; elytra ♂ 19 mm., ♀ 23 mm.; ovipositor 13 mm.

Types: Queensland: Brisbane (H. Hacker, 2, iv, 1918), 1 ♂, 1 ♀ (S.A.M.)

Although very close to the preceding, this species is quite distinct by the shape of the subgenital plate of the male.

3. HEMIPHONUS FRONTALIS (Walk.).

Laurepa frontalis Walker, 1869, Cat. Derm. Salt. Br. M., i., p. 99.

I have seen the type of this species in the British Museum and can add some details to Walker's description:

Testaceous, slender, shining; head blackish above; abdomen with short black bands; lateral lobes of pronotum blackish. Elytral mirror of male small but quite distinct, divided by a transverse vein; apical field very long, with 5 veins, two of which are in the prolongation of the chords; diagonal vein distinct; 4 oblique veins. Length 8 lines.

North Australia: (type in the British Museum).

4. HEMIPHONUS GRACILIS sp. n.

Fig. 78.

♂. Rather small, slender, testaceous. Head with 6 longitudinal yellow lines; frontal rostrum short, almost as wide at top as at base, truncated at apex; face testaceous, smooth, with only a small yellow callosity under each eye,

which is succeeded posteriorly along the eye, by a narrow yellow band. Antennae thick, the first segment with internal margin thin, feebly angular. Palpi short; fourth segment of maxillary palpi very short, brown, fifth wide, securiform, yellow. Pronotum with a rather irregular yellow band on the edge; lateral lobes a little darker than the disk. Subgenital plate rather short, narrowing towards the apex which is rounded and slightly truncated. Elytra translucent; anal vein well marked, angulate; mirror rather large, angulate in front, truncated behind, divided in the middle by a straight vein; 5 oblique veins, the first of which is straight; chords short; apical field long with 4 rather distant, somewhat irregular veins; reticulation sparse and rather irregular.

Length of body 15 mm.; length with wings 22 mm.; post. fem. 8 mm.; elytra 14·5 mm.

Type: Northern Territory: Darwin (G. F. Hill), 1 ♂ (S.A.M.).

This species is characterized by its frontal rostrum which narrows somewhat in front and is truncate, by the well defined mirror, and the veins of the apical field are less close to and less regular than in the other species of the genus.

5. HEMIPHONUS VILLOSICEPS sp. n.

♂. Wholly brownish testaceous. Head on the occiput with a tuft of long erect hairs; vertex feebly concave, shagreened; frontal rostrum triangular, subacute at apex, with somewhat thickened margins, feebly concave surface. Face testaceous, with a yellow callosity under each eye; top of the facial shield with two deep impressions; clypeus with superior margin carinated in the shape of a ∧. Antennae thick, yellowish, with first segment large, somewhat depressed towards the internal margin. Ocelli large, the anterior in the bottom of a gutter nearly at base of rostrum. Maxillary palpi short, yellowish; fourth segment very short, fifth very wide, securiform. Pronotum transverse, with anterior margin concave, a little thickened and in the middle with a tuft of long hairs, corresponding to that of the head; lateral lobes concolorous. Abdomen yellowish; subgenital plate rather long but obtuse at apex. Elytra translucent with yellowish veins covered with very fine hairs; anal vein well marked, angulated; mirror rather well defined, strongly angulate anteriorly and posteriorly, longer than wide, divided behind the middle by a straight vein; 5 oblique veins, of which 1 is straight and 4 are curved, parallel; chords short, the two internal ones curved, parallel apical field long with 6 regularly distant longitudinal veins; Sc with 10 brown branches. Wings a little longer than the elytra.

Length of body 15·5 mm.; length with wings 22 mm.; pronot. 2·4 mm.; elytra 15 mm.

Type: Northern Territory: Groote Eylandt (N. B. Tindale), 1 ♂ (S.A.M.).

Very close to the preceding but distinct in that the frontal rostrum is almost acute at its apex, and the presence of the peculiar pubescence of the head and anterior margin of pronotum; the elytra are more pubescent, the mirror more acute posteriorly and the veins of the apical field more regular.

6. HEMIPHONUS CALLOSIFRONS Chopard.

Hemiphonus callosifrons Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 49, fig. 102.

This species differs from the preceding in the elytral mirror being not completely closed behind and by the face being blackish brown, shining, with yellow callosities.

Queensland: Cooktown (type in the Stockholm Mus.); Townsville (J. E. Young, ix, 1923), (Br. M.); Brisbane (H. Hacker, xii, 1917), (Q.M.); Brisbane (S.A.M.).

Northern Territory: Darwin (S.A.M.).

7. HEMIPHONUS TUBERCULIFRONS Chopard.

Hemiphonus tuberculifrons Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 51.

Fig. 79.

Very close to the preceding but with frontal rostrum almost acute and the facial callosities replaced by small very prominent tubercles. In the male elytron, the chords are more strongly bent but this character seems rather variable.

Western Australia: Kimberley Distr. (type in the Stockholm Mus.).

North Australia: Alexandria, W. Stalker, iv, 1906 (Br. M.).

Central Australia: Horn Exploration, 1894, camp. 23, Hermannsburg, (H. A. Heinrich), Deep Well (K. Johannsen), (S.A.M.).

Northern Territory: Alice Springs, G. Barrett, 1929, McDonnell Downs (S.A.M.).

Gen. HEMIPHONOIDES nov.

Shape very long and narrow; elytral venation as in *Hemiphonus* without trace of a mirror; posterior femora armed with strong tooth on the infero-external margin.

Type of the genus: *Hemiphonoides armatus* sp. n.

HEMIPHONOIDES ARMATUS sp. n.

Fig. 82.

♂. Rather large, very long, colouration of a rather uniform testaceous brown, finely pubescent. Head small, cubital, adorned with 4 yellowish lines on the occiput; vertex sloping, with a wide brown band between the eyes; frontal rostrum very narrow with parallel margins, with a faint brown longitudinal furrow. Face lengthened, yellow. Eyes lengthened dorsally and ventrally; lateral ocelli very big, at base of rostrum, the distance between them scarcely equalling their length; anterior ocellus absent. Antennae and palpi yellowish; maxillary palpi with fourth segment a little shorter than third, fifth rather narrow, securiform. Pronotum as long as wide, with feebly concave anterior margin, posterior margin a little sinuated; disk convex, yellowish brown with a few dark spots near the anterior and posterior margins, with an abundant recumbent pubescence; lateral lobes rather low, with straight inferior margin, much rounded anterior angle. Abdomen brownish above, yellowish beneath; supero-anal valve small, truncated at apex; subgenital plate long, triangular, a little rounded at apex. Genitalia very long, in the shape of a narrow tongue with two processes obliquely directed downwards (fig. 82). Anterior and median legs short, yellowish. Anterior tibiae strongly dilated at base, perforated with a narrow foramen, situated in the bottom of a deep depression, with swollen anterior margin; metatarsus very short, second segment of the tarsus widely flattened. Posterior femora long and narrow, a little spotted with brown at external face; infero-external margin finely denticulated and armed about the apical third with a large, feebly curved tooth; internal margin also finely denticulated; inferior face with a rounded swelling a little before the apex. Posterior tibiae armed with 7 internal, 5 external spines, denticulate between the spines, external spurs very short; internal spurs a little longer, particularly the superior one; metatarsi short, armed with 2 apical denticles and a small one on the external margin, the apical spurs rather long, particularly the internal one. Elytra long and narrow, testaceous brown, finely pubescent; anal vein and axillaries well marked, the anal vein curved at right angle; there is no trace of a mirror, the dorsal field being occupied by 7 almost longitudinal and equidistant veins, of which 4 are branches of the cubital vein and the other 3 are united at base on the anal knot; transverse veinlets rather scarce, forming very long areolae; lateral field rather low; Sc bearing 10 branches. Wings extending little beyond the elytra.

Length of body 21 mm.; length with wings 30 mm.; pronot. 3·2 mm.; post. fem. 13 mm.; elytra 20·5 mm.

Type: Bisiatabu, Pt. Moresby, N.G. (W. N. Lock), 1 ♂ (S.A.M.).

Although evidently allied to *Hemiphonus,* this insect is very remarkable in the armature of the posterior femora, a character which is quite exceptional in the Grylloidea. It is possible that the female sex be without the strong tooth of the external margin but it is almost certain that the unusual denticulation of both inferior margins of the femora exists in this sex.

Gen. MUNDEICUS nov.

The species of this new genus are characterized by the anterior tibiae being perforated both on the internal and the external face; maxillary palpi with last segment rather large, securiform; subcostal vein of elytra with several oblique branches inserted along the whole length of the vein. This last character differentiates this genus from *Anisotrypus* Sauss. and *Munda* Stål, in which the branches of the subcostal vein are few, parallel to the vein and inserted near the base. From *Podoscirtus* Serv., it differs in the shape of the last segment of maxillary palpi which is much broader and more or less securiform; the type of this last genus is the enormous Grylloid *Podoscirtus crocinus* Serv., from Madagascar.

Type of the genus: *Podoscirtus longifemur* Chop.

KEY TO THE SPECIES OF *MUNDEICUS.*

1. Last segment of maxillary palpi strongly securiform, nearly as wide as long; general shape rather short; frontal rostrum not very narrow at top .. .. 2. *brevicauda*

   Last segment of maxillary palpi feebly securiform, distinctly longer than wide; general shape more slender; frontal rostrum very narrow at apex 2

2. Light testaceous brown with a lateral yellow band; pronotum transverse; Sc of elytra bearing 12 branches .. .. .. 1. *longifemur*

   Yellowish brown with a brown lateral band; pronotum almost as long as wide; Sc of elytra bearing 6 branches .. .. .. 3. *tindalei*

1. MUNDEICUS LONGIFEMUR (Chop.)

Podoscirtus longifemur Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 51, fig. 104–105.

Rather slender; light testaceous brown with opaque yellow band on the sides of the pronotum and along the humeral edge of elytra. Occiput with 4

very narrow light lines; frontal rostrum almost triangular; face short, whitish. Lateral lobes of pronotum light yellow, disk rufous yellow, pubescent, with a lateral, yellow, somewhat callous band, bordered inside with brown. Abdomen yellowish; subgenital plate of male very long, triangular. Legs yellowish; posterior tibiae armed on each margin with 5 small spines, black at apex.

Length of body 13 mm.; length with wings 19 mm.; post. fem. 8·5 mm.; elytra 12 mm.

Western Australia: Broome (type in the Stockholm Mus.).

2. MUNDEICUS BREVICAUDA (Chop.).

Podoscirtus brevicauda Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 52, fig. 106–107.

Very close to the preceding; lateral yellow bands of the pronotum not so well marked. Maxillary palpi shorter with four segment very short, fifth scarcely longer than wide. Posterior femora not so slender. Elytra rufous without lateral yellow band. Ovipositor very short, straight with apical valves rounded, with 3 projecting ridges.

Length of body 15 mm.; length with wings 21 mm.; post. fem. 8 mm.; elytra 14 mm.; ovipositor 5·2 mm.

Western Australia: Kimberley Distr. (type in the Stockholm Mus.).

3. MUNDEICUS TINDALEI sp. n.

Fig. 53.

♂. Rather large, yellowish brown with a rather well defined brown band on the head, behind the eyes and on the sides of the pronotum and elytra; covered with a rather abundant white pubescence. Head rather long; frontal rostrum very narrow at apex, feebly furrowed. Face very short, triangular, yellow. Eyes rounded; lateral ocelli rather large, oval, anterior one very small, in the middle of the rostrum. Antennae rather stout, yellowish with a few brown rings; first segment large, a little depressed, adorned above with two small brown lines, uniting in front. Palpi yellow, short; fourth segment of maxillary palpi shorter than third, rather strongly widening at apex, fifth a little longer than third, feebly securiform. Pronotum a little wider than long, anterior margin straight, posterior feebly convex, both mottled with small brown spots; disk almost flat, feebly furrowed in the middle, yellowish brown with two lateral brown bands and a weak brown tinge along the median furrow; insertion of the lateral lobes subangular; these lobes yellow with very

small brown spots, their inferior margin straight. Abdomen brownish above, yellow beneath; subgenital plate long, subacute at apex. Cerci yellow. Genitalia long and narrow; superior piece lamellate, gently narrowing towards the apex which is feebly truncated with a median short point (fig. 83); the inferior pieces are as long as the superior ones, united in a lamellate piece which is overlapped by the decumbent sides of the superior plate. Legs yellow, pubescent, feebly mottled with brown. Anterior and medium legs rather short; femora feebly compressed; anterior tibiae a little dilated at base, perforated with two large, oval tympana; tarsi very short, the metatarsi almost equalling the third segment. Posterior femora slender, feebly enlarged at base, adorned with two weak brown longitudinal lines on the external face; tibiae depressed above, serrulated and armed on each margin with 5 very small spines, scarcely longer than the denticles; external apical spurs very short; internal spurs a little longer, particularly the superior; metatarsi very short with short and stout apical spurs, armed above with 2 small external denticles, 1 internal. Elytral rather narrow, lengthened, light brownish with a feeble brown humeral band, feebly pubescent; dorsal field with 8 rather regular, oblique veins, 5 of which emerge from the cubital vein; transverse veinlets numerous, irregular, more or less anastomosed, forming narrow, long areolae; lateral field a little lighter than the dorsal field; Sc with 6 oblique branches, which are regularly spaced. Wings rather exceedingly surpassing the elytra.

Length of body 14 mm.; length with wings 21 mm.; post. fem. 9·5 mm.

Type: Queensland: Stewart River (Hale and Tindale, Jan., 1927), 1 ♂ (S.A.M.).

Gen. APHONOIDES Chopard, 1940.

This genus differs from *Aphonomorphus* in the shape of the last segment of the maxillary palpi which is long, rather narrow, with apex truncated, instead of short and strongly securiform. They are numerous in the Austro-Malay region; only a few have been recorded from Australia and there certainly remains quite a number to be discovered.

KEY TO THE SPECIES OF *APHONOIDES*.

1. General shape very much lengthened, elytra at least five times as long as wide, with straight sides 2
   General shape much shorter, elytra hardly four times as long as wide, with feebly convex sides .. .. 4. *brevis*
2. Face black .. .. 5. *hackeri*
   Face yellow 3

3. General shape strongly elongate; pronotum as long as wide
2. *angustissimus*
General shape a little shorter; pronotum distinctly wider than long 4

4. Very pale yellow with a brown band on the elytral edge; frontal rostrum very narrow at apex; fifth segment of maxillary palpi rather wide .. .. 3. *lividus*
Testaceous brown; frontal rostrum not so narrow; fifth segment of maxillary palpi feebly enlarged .. .. 1. *australis*

1. APHONOIDES AUSTRALIS (Walk.).

Laurepa australis Walker, 1869, Cat. Derm. Salt. Br. M., i, . 98.

Aphonomorphus debilis Chopard, 1925, Ark, f. Zool, 18A, No. 6, p. 54, fig. 108–109.

Fig. 84.

Rather slender; uniformly testaceous brown. Frontal rostrum a little narrower than the first antennal segment, narrowing feebly in front; fifth segment of maxillary palpi hardly widening at apex. Ocelli rather big, the anterior in the middle of the rostrum. Pronotum testaceous brown with two more or less visible brown impressions. Abdomen yellowish brown; cerci very long, yellow. Genitalia of male rather wide, feebly notched at apex (fig. 84). Ovipositor short, straight with small apical valves, their external face very finely spinulose, the inferior margin with a large tooth and three small, rounded ones; apex with two acute teeth. Legs of the same colour as the body, pubescent; posterior femora long and rather slender, with two brown spots above. Elytra testaceous brown, finely pubescent, with yellowish veins; dorsal field with 4 oblique, regularly spaced veins, the last one with 4 branches. Wings a little longer than the elytra.

Length of body 12 mm.; length with wings 19 mm.; post. fem. 9 mm.; elytra 12·5 mm.; ovipositor 8 mm.

Queensland: Malanda (types of *debilis* in the Stockholm Mus.); Atherton, Yarrabah, Cedar Creek, Cape Yorke (Stockholm Mus.); Cairns, Normanton (S.A.M.); Brisbane (Q.M.); Almaden, Chillagoe Dist. (A.M.).

Northern Territory: Roper River, Groote Eylandt (S.A.M.).

2. APHONOIDES ANGUSTISSIMUS (Chop.).

Aphonomorphus angustissimus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 55, fig. 110.

Extremely slender, yellowish; fifth segment of maxillary palpi rather large and wide. Abdomen narrow; subgenital plate of the male rather large, much

rounded at apex. Ovipositor short, almost straight, with small, rounded apical valves, the superior ones almost smooth, with 2 rounded teeth on inferior margin and 2 acute teeth at apex. Posterior femora long and slender. Elytra very narrow; dorsal field with 4 straight veins, the 4th being twice furcate. Wings rather exceedingly surpassing the elytra.

Length of body 11·5 mm.; length with wings 14 mm.; post. fem. 8 mm.; elytra 10·5 mm.; ovipositor 5 mm.

Queensland: Yarrabah (types in the Stockholm Mus.), Cape Yorke, Alice River (Stockholm Mus.); Cairns (S.A.M.).

Northern Territory: Groote Eylandt (N. B. Tindale), (S.A.M.).

3. APHONOIDES LIVIDUS sp. n.

♂. Size medium; rather slender; colouration very pale with a brown band near the external edge of the dorsal field of elytra; covered with a whitish pubescence. Head pale yellow, a little flattened above; frontal rostrum with feebly projecting sides, strongly converging forwards, apex very narrow. Face yellow with a few small brown spots in the superior part of the facial shield. Eyes a little lengthened dorso-ventrally, projecting feebly forwards; ocelli small, almost of the same size, the anterior one in the middle of the rostrum. Antennae yellow, even the two first segments. Palpi yellow; fourth segment of maxillary palpi short, fifth large, rather narrow, feebly securiform in shape. Pronotum one and a quarter times as wide as long, with anterior margin straight, posterior sinuate; disk feebly convex, yellowish with a whitish, close pubescence; lateral lobes long, whitish, with inferior margin almost straight. anterior angle strongly rounded. Abdomen and cerci pale yellow; subgenital plate short, widely rounded at apex. Legs yellowish, pubescent; anterior tibiae feebly dilated, perforated with a larger oval tympanum on the internal face. Posterior femora moderately long, rather strongly dilated at base, tibiae armed with 5 external, 6 internal, yellow with black top spines; the external margin bears numerous denticles before the first spine, and 1 or 2 such denticles between the spines; on the internal margin, they are much less numerous at base and one only between the first and the second spines; metatarsi short, with long apical spurs and 3 external, 1 internal denticle above. Elytra long and narrow, yellowish with a brown humeral band which is interrupted in the middle; dorsal field finely pubescent, with 6 feebly oblique, very regularly spaced veins; lateral field whitish, almost translucent; Sc with 6 branches between which there are a few transverse, yellow veinlets. Wings rather longly caudate.

Length of body 10 mm.; length with wings 16·5 mm.; elytra 11 mm.; post. fem. 7 mm.

Type: Western Australia (Dr. H. Basedow), 1 ♂ (A.M.).

This species is close to the preceding but is not so narrow and has a different colouration; it is also very close to a Bornean species *A. pallens* Chop., in which the subgenital plate is very long.

4. APHONOIDES BREVIS sp. n.

General shape shorter than in the preceding species; testaceous brown with the transverse veinlets of elytra yellow, somewhat thickened. Head as wide as a pronotum; vertex declivous, a little flattened; frontal rostrum somewhat darkened, feebly narrowing in front, with apex truncated, a little narrower than first antennal segment. Face short, triangular, yellow. Eyes rounded, moderately projecting; ocelli small, disposed in a triangle. Antennae yellowish with a few small brown rings. Palpi yellowish; fourth segment of maxillary palpi shorter than third, fifth equalling third, feebly securiform with convex superior margin. Pronotum a little wider than long, narrowing very weakly in front, with anterior margin straight, posterior rather convex, subangulate; disk convex, yellowish brown; lateral lobes with slightly convex inferior margin, angles rounded, yellowish, lighter than the disk. Abdomen yellowish brown. Cerci yellow. ♂. Subgenital plate rather short, almost rounded at apex. Genitalia very short, forming a triangular piece, deeply and widely notched at apex. ♀. Subgenital plate short and wide, with feebly notched apex. Ovipositor rather short and stout; apical valves narrow, lengthened, rugulose at external face, ending in 3 strong, rounded teeth. Legs yellowish, pubescent; anterior tibiae short, rather strongly swollen at base, perforated on the internal side with a rather large, oval tympanum; tarsi very short. Posterior femora moderately dilated at base, gently tapering to the apex; tibiae armed with 5 external, 6 internal spines, rather strongly denticulated at base and between the spines; apical spurs short. Elytra a little longer than the body, rather wide, finely pubescent, greyish testaceous with more or less yellowish transverse veinlets; principal veins very feebly oblique, regularly spaced, 7 in number of which 3 are free and 4 are branches of the curbital vein; transverse veinlets forming long, rather regular areolae; lateral field almost translucent; Sc with 5 branches.

Both sexes are quite similar, the male being only a little more slender than the female.

Length of body ♂ 11·5 mm., ♀ 12 mm.; length with wings ♂ 16 mm.,

♀ 17 mm.; post fem. 7·4 mm.; elytra ♂ 10·2 mm.; ♀ 10·8 mm.; ovipositor 5·6 mm.

Types: Queensland: Cairns Distr. (A. M. Lea), 1 ♂; Nanango Distr. (H. Hacker, 26, iii, 1928), 1 ♀ (Q.M.).

This species looks very much like *australis* but it is not so slender.

5. APHONOIDES HACKERI sp. n.

Fig. 15, 85–86.

♂. Long and slender; greyish varied with light brown, rather pubescent. Head as wide as pronotum in front, short, adorned above with 5 irregular, brown bands, the median being wide; frontal rostrum feebly concave, very narrow at apex; face dark brown, shining with a yellow spot at top of the facial shield; cheeks yellow with two narrow, parallel, brown bands behind the eye. Antennae brown, annulated with yellow; first segment large, yellowish, with irregular brown lines above. Palpi yellow; maxillary palpi short, particularly the fourth segment; fifth segment equalling the second and third together, feebly enlarged at apex, with convex superior margin, apex obliquely truncated. Pronotum a little wider than long, narrowing feebly in front; anterior margin feebly convex, posterior margin subangulate; disk yellowish grey, spotted with brown, the median line yellow bordered with brown; anterior margin adorned with a few larger brown points; lateral lobes not very high, with straight inferior margin, with a brown band on the edge and numerous small brown points. Abdomen yellowish grey; subgenital plate rather large, rounded at apex. Genitalia very short, notched at apex (fig. 85, 86). Anterior and median legs short, pubescent, yellowish grey, spotted with brown; inferior face of the tibiae wholly brown. Posterior femora long and narrow, spotted with brown; posterior tibiae pubescent, armed with 4 external, 5 internal spines, finely serrulated between the spines, brown with whitish spots above; external apical spurs very short; internal spurs of medium size, the superior one the longest; metatarsi short; compressed. Elytra long and narrow, greyish spotted with brown in the areolae; dorsal field with 3 free veins and 4 branches of the cubital vein; Sc with 7 branches. Wings speckled with brown, rather longly surpassing the elytra.

Length of body 12·5 mm.; length with wings 19 mm.; post. fem. 10 mm.; elytra 12 mm.

Type: Queensland: Brisbane (H. Hacker, 13, iii, 1918), 1 ♂ (Q.M.).

A very distinctive species in its colouration and the abundant pubescence on the legs.

Gen. ADENOPTERUS nov.[1]

General shape short; frontal rostrum narrow at apex but feebly truncated; fifth segment of maxillary palpi rather wide but scarcely wider at apex than at base. Anterior tibiae perforated on both sides; posterior femora short and stout. Elytra scarcely extending to the apex of abdomen; venation similar in both sexes; radial vein of the male with at base a strong glandular deformation. Wings scarcely exceeding the elytra in length.

Type of the genus: *Adenopterus norfolkensis* sp. n.

This genus differs from *Aphonoides* not only in the presence of two tympana on the anterior tibiae and of a glandular pit on the male elytra, but also in the shorter general shape and the wings which are hardly longer than the elytra. It is also close to *Mundeicus* from which it differs by the short general shape, the specialized elytra and the branches of Sc which are only 2 or 3 in number.

ADENOPTERUS NORFOLKENSIS sp. n.

Fig. 16, 87, 88, 89.

♂. Small, general shape short and wide; uniformly rufo-testaceous. Head as wide as pronotum, testaceous with 5 darker bands on the occiput; vertex sloping, a little flattened, narrow at top, almost triangular. Antennae and palpi rufo-testaceous; the three last segments of the maxillary palpi almost equal in length, the last one wide, feebly securiform. Eyes rounded; ocelli very small, the anterior one in the middle of the rostrum, in the bottom of a furrow. Pronotum a little wider than long, with parallel sides, anterior margin very slightly concave, posterior margin straight; lateral lobes darker than the disk, with feebly convex inferior margin, posterior angle rounded, anterior a little more than 90°. Abdomen brown above, shining, rufous beneath; subgenital plate large, ending in a long triangular, plate bearing at apex a small, narrow projection (with parallel sides). Genitalia formed of a large tectiform superior piece, ending in a small erected tooth, and two inferior slender hooks (fig. 89). Cerci rather long, testaceous. Legs rather long; anterior and medium femora a little compressed, yellowish with feebly darkened apex; anterior tibiae perforated with a small, oval tympanum on the external face and a smaller one partly obliterated on the internal face; tarsi very short, the metatarsi hardly longer than the second segment, which is strongly depressed. Posterior femora short and stout; tibiae slender, armed with 6 small spines on each superior margin, finely serrulated at base and between the spines;

[1] From ἀδην, gland, owing to the glandular specialization on the male elytra.

external apical spurs short, median a little longer than the other two; internal spurs also short but the longest is the superior; metatarsi short, armed above with 2 internal, 3 external denticles. Elytra scarcely extending to the apex of the abdomen, of a translucent greyish; dorsal field rather narrow; cubital vein with two branches, Cu 1 a little thickened and strongly curved at base; anal and axillary veins almost longitudinal, parallel; transverse veinlets few in number, yellow, with 4 oblique branches; radial vein with at base a strong flexure in the middle of which is placed a small glandular cupule (fig. 87, 88); between R and Sc, there is a series of yellow, thick veinlets. Wings not longer than the elytra.

♀. A little larger than the male with the brown parts of the head, pronotum and femora more rufous. Subgenital plate a little narrowing at apex, which is feebly notched. Ovipositor rather long, slender, slightly bent upwards; apical valves long and narrow, subacute at apex, with external face finely grained, inferior margin feebly undulated with a strong basal tooth. Elytra with venation very similar to that of the male, except for the radial vein which is simply deviated at base, without glandular pit; Sc also less strongly undulated.

Length of body ♂ 9·6 mm., ♀ 11 mm.; post. fem. ♂ 6·5 mm., ♀ 7·6 mm.; elytra ♂ 6·8 mm., ♀ 8 mm.; ovipositor 9 mm.

Types: Norfolk Island (A. M. Lea), 1 ♂, 1♀ (S.A.M.).

A small series from the same locality as the types, composed of 4 males, 3 females, shows that the species is very constant in its characters.

Gen. EUSCYRTUS Guérin, 1844.

The species of this genus are easy to recognize by their very slender shape and by the ovipositor of the female which is completely without specialized apical valves. A few species only are known inhabiting the Indo-Australian region, Madagascar and Africa; it is interesting to note that one species has been described by Saussure from Mexico.

KEY TO THE SPECIES OF *EUSCYRTUS*.

1. Frontal rostrum wider than the first segment of antennae, almost square; elytra much shorter than the abdomen .. ..1. *hemelytrus*
   Frontal rostrum narrower than the first antennal segment of antennae; much longer than wide; elytra extending almost to the apex of abdomen 2
2. Size smaller (12 mm.); ovipositor strongly curved .. 2. *concinnus*
   Size larger (15 mm.); ovipositor almost straight .. 3. *australicus*

1. EUSCYRTUS HEMELYTRUS (Haan).

Gryllus (Encoptera) hemelytrus Haan, 1842, Temm. Verhandl., Orth., p. 231, pl. 20, fig. 2.

Euscyrtus hemelytrus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 56.

Small and slender with a very distinct pattern. Head brown above, adorned with 4 light lines; pronotum dark brown with two lateral yellow bands. Elytra greyish with a yellow humeral band, covering only the four first abdominal tergites; exposed portion of abdomen with two submedian brown lines, sixth tergite with two brown spots.

Length of body 9 mm.; post. fem. 7 mm.; elytra 3 mm.; ovipositor 8 mm.

Queensland: Bellenden Ker (Stockholm Mus.).

Northern Territory: Darwin (G. F. Hill); Groote Eylandt (N. B. Tindale), (S.A.M.).

This species is very common and widely distributed in India, the Malay Archipelago and as far as Japan.

2. EUSCYRTUS CONCINNUS (Haan).

Gryllus (Eneoptera) concinnus Haan, 1842, Temm. Verhandl., Orth., p. 231, pl. 20, fig. 3.

A little larger than the preceding but with a much less distinct pattern, often almost completely testaceous; very distinct from *hemelytrus* in the shape of the frontal rostrum.

I have not seen an example of this species from Australia but I think it will be found in Queensland, as it is common and as widely spread as the preceding.

3. EUSCYRTUS AUSTRALICUS Chopard.

Euscyrtus australicus Chopard, 1925, Ark. f. Zool., 18A, No. 6, p. 56.

This species is close to the preceding, being of a rather uniform testaceous colouration with a very narrow frontal rostrum. The elytra extend almost to the apex of abdomen; they are almost transparent with the lateral field a little darker and the veins rufous brownish; wings longer than the elytra. But the shape of the ovipositor is very different from both preceding species; this organ is a little flattened, almost straight, only feebly curved downwards near the extremity.

Length of body 15 mm.; length with wings 16 mm.; post. fem. 9·5 mm.; elytra 9 mm.; ovipositor 14 mm.

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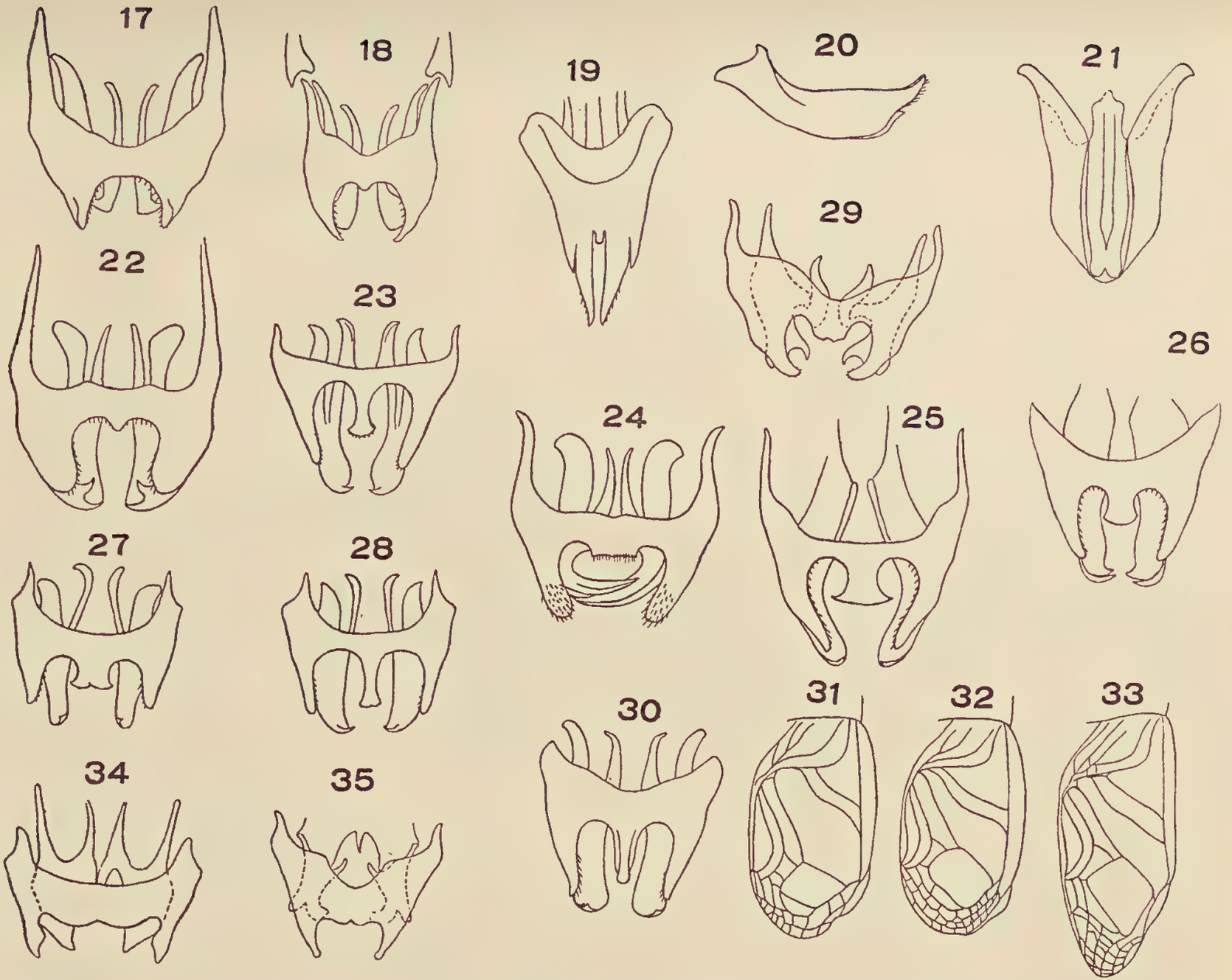

Fig. 17–35. Genitalia; 17. *Cephalogryllus australicus;* 18. *C. laeviceps*; 19. *Anurogryllus australis*; 20. *Gryllulus commodus,* side view; 21. Same, dorsal view; 22. *G. lepidus* (from Beverley, W.A.); 23. *G. lineiceps*; 24. *G. fulviceps*; 25. *G. comparatus*; 26. *G. scutellatus*; 27. *G. parvulus*; 28. *G. minusculus*; 29. *G. mediocris*; 30. *G. kempi*; 31. Right elytron of *G. parvulus*; 32. Same of *G. minusculus;* 33. Same of *G. kempi;* 34. Male genitalia of *Eugryllodes diminutus*; 35. Same of *Loxoblemmus pallens.*

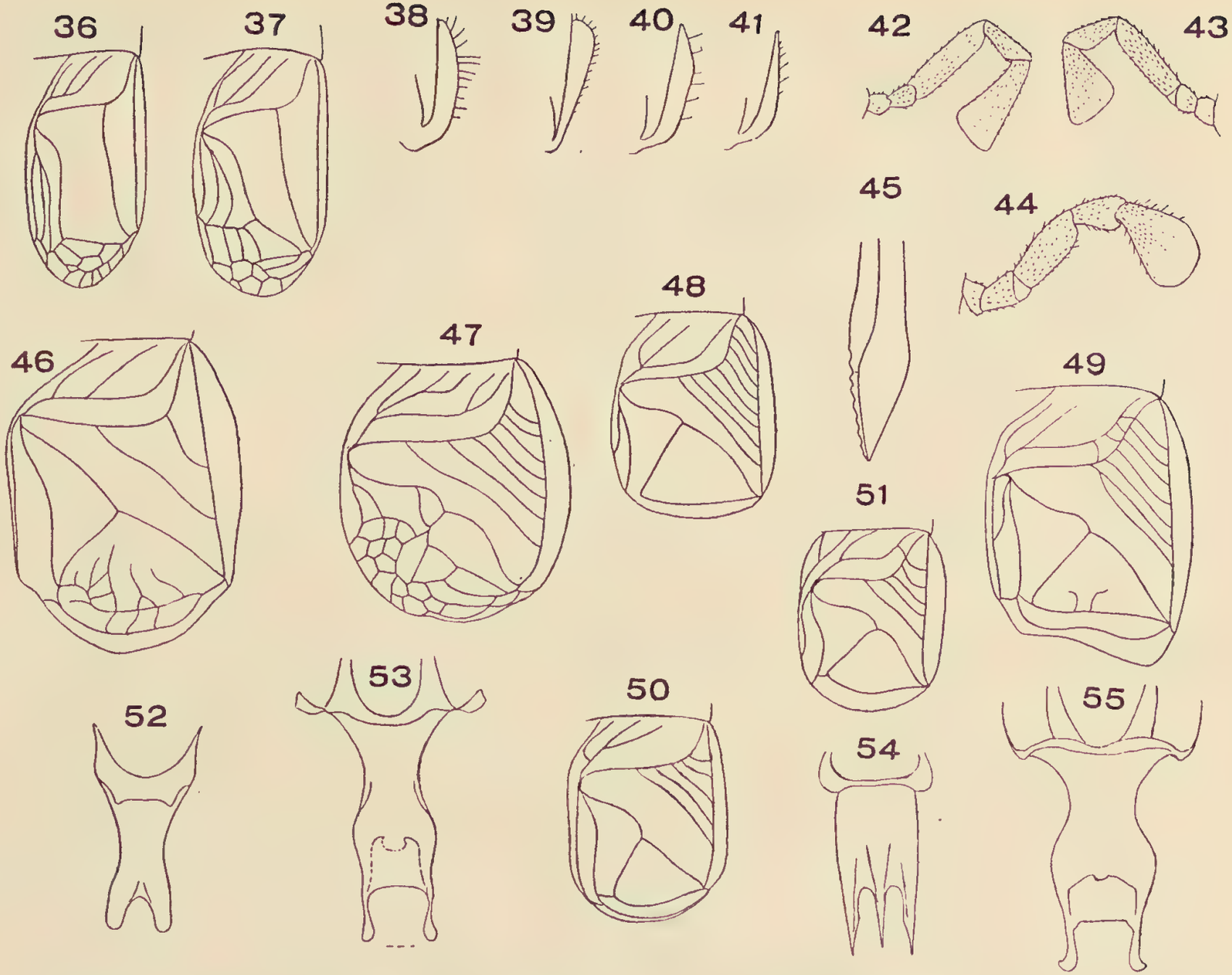

Fig. 36–45. 36. Elytron of *Pteronemobius regulus* ♂; 37. Same, *Pt. ornaticeps*; 38. Process of anal valves (paraprocts) *Ornebius curtipalpis*; 39. Same, *O. howensis*; 40. Same, *O. brevithorax*; 41. Same, *O. nigromaculatus*; 42. Maxillary palpus, *O. nigromaculatus*; 43. Same, *O. curtipalpis*; 44. Same, *O. fascipes*; 45. Apex of ovipositor, *O. denticauda*. Fig. 46–51: Elytra of males of *Endacusta*: 46. *oligoneura*; 47. *angulifrons*; 48. *mjobergi*; 49. *major*; 50. *australis*; 51. *minor*. Fig. 52–55: Genitalia of males of *Endacusta*: 52. *australis*; 53. *irrorata*; 54. *major*; 55. *mjobergi*.

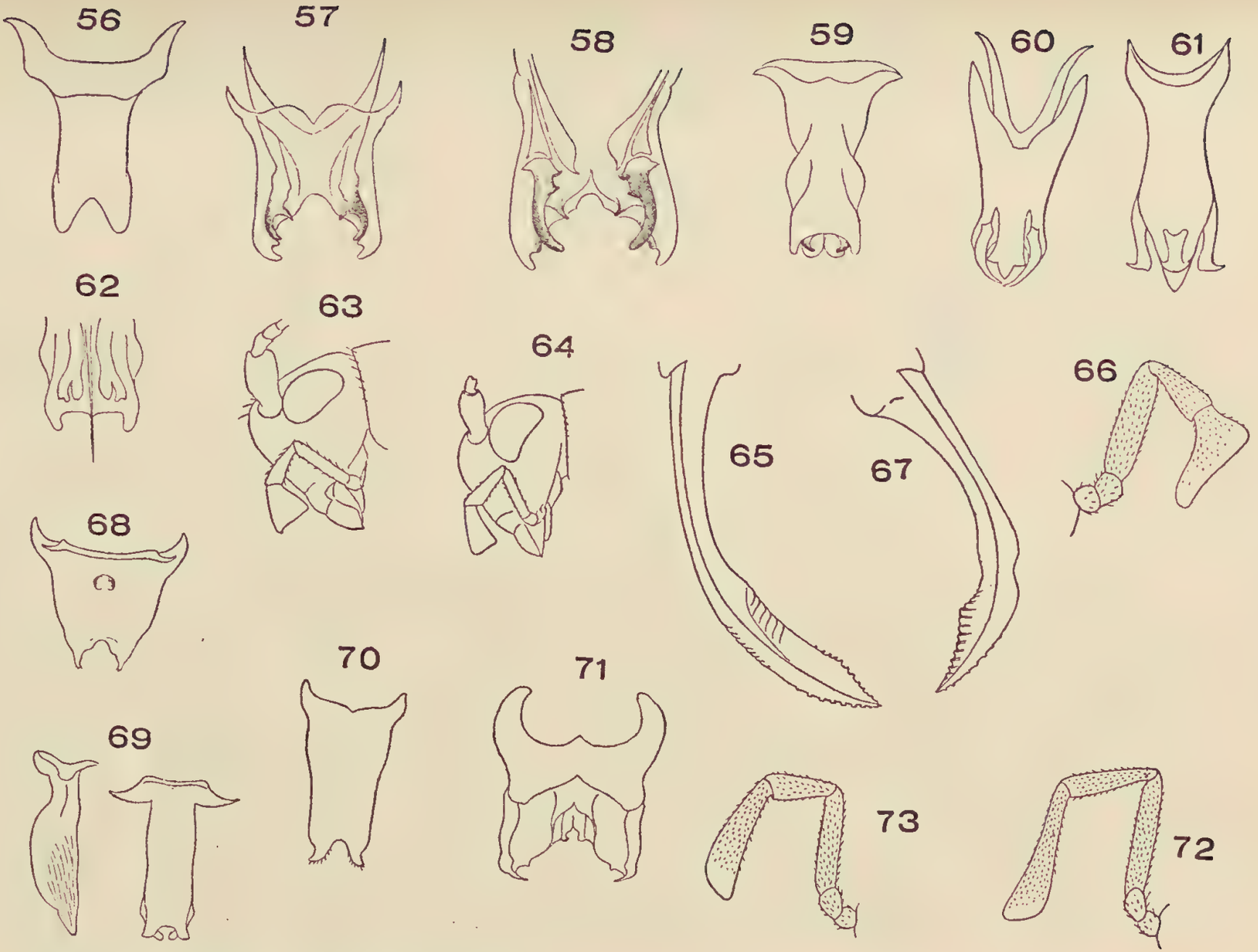

Fig. 56–73. Genitalia of males of *Endacusta*: 56. *minor*; 57. *angulifrons*; 58. Extremity of same from beneath; 59. *cycloptera*; 60. *oligoneura*; 61. *Endotaria aptera*; 62. Extremity of same from beneath; 63. Head of *Cyrtoxiphoides*; 64. Head of *Anaxipha*; 65. Ovipostor, *Cyrtoxiphoides planifrons*; 66. Maxillary palpus of *Metiochodes tindalei*; 67. Ovipositor of same; 68. Male genitalia of *Lebinthus bifasciatus*; 69. Male genitalia of *Salmanites obscurifrons*, from above and lateral view; 70. Same of *Eurepa unicolor*; 71. Same of *Tremellia australis*; 72. Maxillary palpus of *Madasumma affinis*; 73. Same of *M. hornensis*.

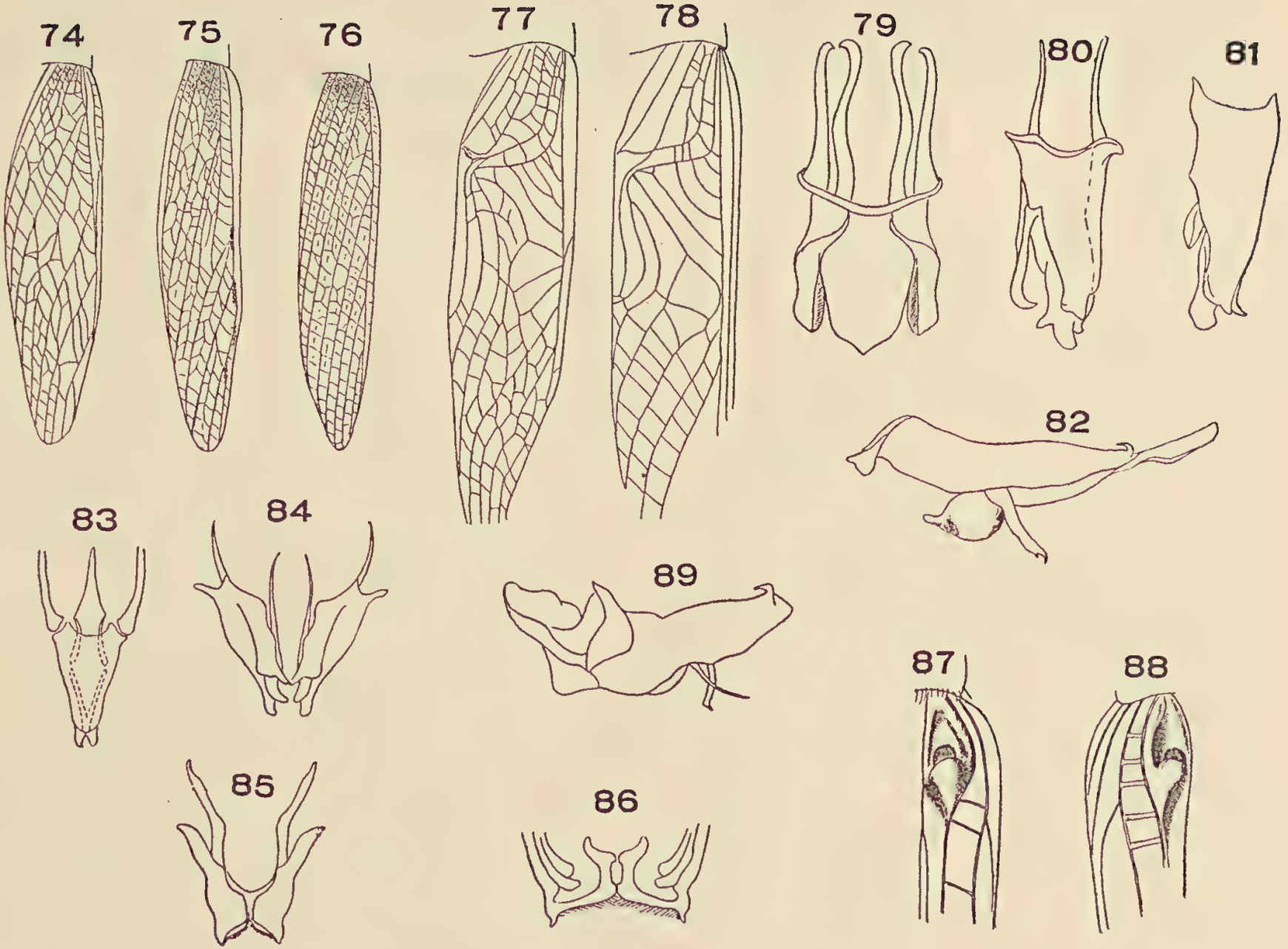

Fig. 74–89. Right elytron of *Madasumma reticulata*; 75. Same of *M. planiceps*; 76. Same of *M. hornensis*; 77. Same of *Hemiphonus vittatus*; 78. Same of *H. gracilis*; 79. Genitalia of *vittatus*, lateral view; 81. Same of *H. vicinus*; 82. Same of *H vittatus*, lateral view; 81. Same of *H. vicinus*; 82. Same of *Hemiphonoides armatus*; 83. Male genitalia of *Mundeicus tindalei*; 84. Same of *Aphonoides australis*; 85. Same of *A. hackeri*; 86. Extremity of same from beneath; 87. *Adenopterus norfolkensis*, base of right elytron from above; 88. Same of left elytron, lateral view; 89. Genitalia of *Adenopterus norfolkensis*.

APPENDIX.

DESCRIPTIONS OF PAPUAN SPECIES.

The collections of the various Australian Museums contain a certain number of new species from New Guinea, which are described below. Some of these species probably occur in North Australia.

XABEA PODOSCIRTOIDES sp. n. (Oecanthidae).

♀ *Holotype.* Size medium, rather slender; yellowish white. Head long, depressed between the eyes. Antennae and palpi yellowish white. Pronotum a little longer than wide backwards; disk strongly embossed, the median line furrowed except near the anterior margin where it has a small carina; on each side of this carina 6 or 7 small elevated ridges are visible; lateral lobes with a lobiform enlargement a little behind the middle. Abdomen yellowish. Cerci short and rather stout. Ovipositor short, straight, with apical valves oval, subacute at apex; their external face with 4 strong prominent ridges. Legs whitish; anterior tibiae strongly dilated at base, perforated with two tympana, the internal very large, the external smaller; posterior tibiae without spines Elytra whitish, almost transparent, rather wide; dorsal field with a very wide, rather irregular reticulation; Cu with 4 branches; lateral field rather wide, Sc with 4 branches; R very distant from Sc, the space between them occupied by rather regular transverse veinlets. Wings rather markedly surpassing the elytra.

♂ *Allotype.* Head and pronotum as in the female; head adorned with a few small rufous spots behind the eyes and a small band of the same colour between them. Elytra rather narrow, adorned with 7 very light brown spots, 3 in the angles of the triangle formed by the first chord, the diagonal vein and the antero-internal margin of the mirror, the other 4 in the mirror itself; this is a little longer than wide, with right anterior margin, divided in the middle by a straight vein. Cerci short.

Length of body ♂ 10·5 mm., ♀ 11 mm.; length with wings ♂ 16 mm., ♀ 17·5 mm.; elytra ♂ 8 mm., ♀ 9·5 mm.; post. fem. ♂ 5·5 mm., ♀ 6 mm.; ovipositor 5·5 mm.

Types: N.E. Papua: Mt. Lamington, 1,300–1,500 ft. (C. T. McNamara), 1 ♀ (S.A.M).; Torres Straits, Murray Island (A. M. Lea), 1 ♂ (S.A.M.).

This species is remarkable in the shape of the lateral lobes of pronotum and particularly in the ovipositor of the female, the apical valves of which

differ from the other Oecanthidae and are quite similar to those of the Podoscirtidae.

PENTACENTRUS NIGRESCENS sp. n. (Pentacentridae).

♂ *Holotype.* Blackish, feebly pubescent. Head almost flat above, with fine transverse ridges between the eyes and two longitudinal punctate bands on the occiput; frontal rostrum almost as wide as the first antennal segment at apex; face very short, blackish. Eyes transversally lengthened; ocelli small, subequal. Palpi black; fourth segment of maxillary palpi shorter than third and fifth, the last one triangular in shape. Pronotum one and a quarter times as wide as long, with anterior margin straight, posterior strongly rounded disk very weakly convex, blackish, unicolorous; lateral lobes strongly rounded in front. Abdomen and cerci black. Genitalia formed of a thick superior piece which is deeply notched at apex, forming two lobes almost quadrangular in shape with smooth superior margin; in the bottom of the notch a small projection arises, divided at apex into two sharp points. Legs blackish; anterior tibiae with a large internal tympanum. Posterior femora unicolorous, finely pubescent; tibiae with rufous spines; posterior metatarsi very long with finely serrulated superior margin. Epiproct (supero-anal valve) subrectangular in shape, rather strongly narrowing backwards, nearly smooth, furrowed in the middle; subgenital plate large, a little narrower at apex, with rounded angles Elytra of a very dark brown above, with almost black lateral field. Wings smoky, somewhat irridescent.

Length of body 7·5 mm.; length with wings 10·5 mm.

Type: N.E. Papua: Mt. Lamington, 1,300–1,500 ft. (C. T. McNamara), 1 ♂ (S.A.M.).

PENTACENTROUS SOROR sp. n.

♂ *Holotype.* Very close to the preceding; larger. Ocelli larger; antennae thick, with the first two segments brown; the remainder yellow with a wide brown portion about the middle. Legs and cerci yellowish. Epiproct almost square, with apical margin a little sinuated and thickened; its surface finely and regularly punctuated with two oblique prominent lines near the base, with a tuft of stiff bristles. Genitalia of the same type as the preceding species, strongly sclerified, in the shape of two large triangular plates, the superior margin of which is armed with three small teeth; apical part divided into two small acute teeth. Elytra with anal vein not quite so straight as in *nigrescens*; cubito-anal space relatively narrower, with less numerous, not so regular and less sinuated transverse veinlets.

Length of body 9·5 mm.; length with wings 13 mm.
Type: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂ (A.M.).

PENTACENTRUS PAPUANUS sp. n.

♂ *Holotype.* Blackish with translucent spots on the elytra. Head black; flattened, declivous above, feebly punctate and provided with long, rufous, sparse hairs; frontal rostrum a little narrowing at apex, nearly as wide as the first antennal segment. Face black, short and wide. Eyes rounded, projecting; lateral ocelli rather big, round, anterior very small, in the middle of the rostrum. Antennae broken. Palpi black; fifth segment of maxillary palpi triangular, obliquely truncate. Pronotum a little wider than long, black, shining with rufous, erect hairs; posterior margin sinuate; disk feebly convex, furrowed in the middle; lateral lobes blackish, with convex inferior margin, much rounded anterior angle. Abdomen blackish; epiproct almost square with rounded angles. Genitalia feebly chitinized, composed of two large rectangular plates, with rounded angles, with at their apical margin 5 or 6 long recumbent bristles and 3 still longer, obliquely erect bristles near the internal margin; between the two plates, at base, there is a small furcate projection. Anterior and median legs rufous; anterior tibiae perforated with a large internal tympanum. Posterior legs wanting. Elytra blackish brown with translucent spots; a large spot at base between Sc and M; several smaller spots in the same space, farther from the base; another rather large spot near the base between the cubital and anal veins, and 3 small ones towards the apex of the same space. The veins separated by very irregular distances, R rather markedly sinuate and remote from M; this last vein very close to the cubital, which is furcate a little before the apex; An also very remote from Cu, curved at base; the whole surface of the elytron is filled with very small tubercles, some times very distant from one another, except along the principal veins, where they are very close. Wings longer than the elytra, blackish.

♀ *Allotype.* Similar to the male; elytral venation almost the same with anal vein not so strongly curved at base. Ovipositor rather short, with apical valves long, scarcely wider than the stem, lanceolate.

Length of body ♂ 7·5 mm., ♀ 8 mm.; length with wings 12 mm.
Types: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂, 1 ♀ (S.A.M.)

ORNEBIUS LEAI sp. n. (Mogoplistidae).

♂ *Holotype.* Small; testaceous covered with grey and brown scales. Head with frontal rostrum as wide as first antennal segment; face very short, testaceous marbled with brown. Maxillary palpi yellow with a few brown spots;

fourth segment very short, fifth short and wide, triangular, a little darkened at apex. Pronotum as long as wide backwards, feebly narrowing in front, with anterior margin straight, posterior margin feebly convex. Abdomen brown above, yellow beneath. Cerci yellow, spotted with brown; process of the anal valves yellow, oblique, feebly flattened, rounded but not thickened at apex. Anterior and median femora covered with white and brown scales; tibiae with two rather neat brown rings; posterior tibiae spotted with brown, metatarsi brown at apex. Elytra widely discovered, whitish, a little milky, with 3 large brown spots along the posterior margin and one in the internal angle of the mirror; this one is as long as wide, almost regularly rounded on the external and posterior margins, with widely open anterior and internal angles; diagonal vein rather long.

Length of body 6 mm.; pronot. 2 mm.; post. fem. 3·2 mm.; elytra 2 mm.

Rather close to *O. angustifrons* Chop., from Sarawak, but with shorter pronotum and elytra more completely freed.

Type: Fiji: Ovalau (A. M. Lea, June, 1924), 1 ♂ (S.A.M.).

ANAXIPHA PAPUANA sp. n. (Trigonidiidae).

♀ *Holotype.* Size relatively large for the genus; wings very long; colouration light testaceous brown. Head wider than the pronotum in front, very convex above; frontal rostrum short, rounded, almost as wide as the first antennal segment. Face yellow with a median longitudinal brown band. Eyes rounded, rather projecting. Antennae and palpi yellowish; fourth segment of the maxillary palpi shorter than third, fifth equalling the third in length, in the shape of a long triangle. Pronotum a little narrowing in front, convex above, provided with long brown bristles; lateral lobes concolorous, with strongly rounded anterior angle. Abdomen brownish, pubescent. Ovipositor short, feebly curved, with apical valves wide, occupying almost half the total length, limited at base by two transverse ridges, rather strongly denticulated towards the apex. Legs of the same colour as the body, pubescent; anterior tibiae perforated with two tympana; posterior femora adorned with a longitudinal brown band. Elytra testaceous; veins of the dorsal field almost longitudinal, weakly prominent; lateral field strongly widening at base, with 4 veins, the third and fourth of which are strongly curved. Wings much longer than the elytra, a little darkened.

Length of body 5·5 mm.; length with wings 12 mm.; post. fem. 5·5 mm.; elytra 4 mm.; ovipositor 2·2 mm.

Type: N.E. Papua: Mt. Lamington, 1,300–1,500 ft. (C. T. McNamara), 1 ♀ (S.A.M.).

This species is rather close to *A. bifasciata* Chop., from New Guinea but with longer wings and posterior femora, adorned with one longitudinal band only. It is also close to *longealata* Chop., from Sarawak, which is smaller with concolorous legs.

Gen. GRYLLAPHONUS nov. (Podoscirtidae).

Shape rather short; head flattened above, strongly punctuated; frontal rostrum very narrow at apex; fifth segment of maxillary palpi large and rather wide, securiform. Pronotum very strongly punctuated. Anterior tibiae perforated on the internal face with an oval tympanum, external face non-perforated. Elytra with almost longitudinal, close veins, finely striated between the veins; Sc with two branches emerging from the base.

Type of the genus: *Gryllaphonus striatipennis* sp. n.

GRYLLAPHONUS STRIATIPENNIS sp. n.

♀ *Holotype.* Rather uniformly brown. Head as wide as pronotum; vertex sloping, flat with a strong punctation and a small Y-shaped carina, uniting the ocelli; frontal rostrum very narrow at apex, which is feebly rounded. Face very long, brown, smooth. Eyes dorso-ventrally lengthened, narrowing downwards; ocelli small, disposed in a triangle, the anterior one in a small depression in the middle of the rostrum. Antennae yellowish, with first segment large, a little flattened, brownish. Palpi yellow; fourth segment of the maxillary palpi much shorter than third, fifth large, rather wide, with regularly convex superior and apical margins. Pronotum brown, strongly and regularly punctuated; anterior margin very feebly concave, posterior margin sinuated, both strongly lined; disk weakly convex, the punctuation almost regular except on the usual impressions which are feebly visible; lateral lobes concolorous with inferior margin slightly ascending forwards; the punctuation is replaced by a dainty reticulation. Abdomen brown above, yellowish beneath; subgenital plate small, narrowing and a little truncated at apex. Ovipositor rather short, straight; apical valves punctuated at their external face with a denticulated ridge near the apex. Legs short. Anterior femora testaceous brown; tibiae darkened above, perforated on their internal face with rather large, oval tympanum; external face feebly depressed without a tympanum; median femora a little darker than the anterior ones. Posterior femora wide, brown with a yellow ring a little before the apex; tibiae serrulated, armed with 3 external, 4 internal spines; external apical spurs very short; median and superior internal spurs a little longer, subequal in length; metatarsi short, yellow with apex brown, armed above with 2 apical spines and 3 on the external margin. Elytra rather long, testaceous brown, shining; dorsal field with

very close veins, Cu with 4 branches, Cu p divided at base, 5 anal and axillary veins; between the principal veins, there are rather weak false veins and a fine transverse striation; transverse veinlets forming very long areolae. Lateral field high, with the same aspect as the dorsal field; Sc with two branches rising from the base. Wings feebly surpassing the elytra, brown, finely pubescent.

♂ *Allotype.* Similar to the female. Subgenital plate long, feebly narrowing towards the apex which is rounded, deeply furrowed. Genitalia long and narrow, weakly notched at apex.

Length of body 10 mm.; length with wings 14 mm.; post. fem. 6·2 mm.; elytra 10 mm.; ovipositor 6·5 mm.

Types: Fiji: Taveuni (A. M. Lea), 1 ♀, 1 ♂ (S.A.M.).

This species has quite a number of characteristic features: dense punctuation, close veins and striation of the elytra, short and stout posterior femora. The new genus in which it belongs can be placed close to *Munda* and *Aphonoides.*

MUNDA PUNCTIPES sp. n.

♀ *Holotype.* Rather large, testaceous brown, a little spotted with yellow, finely pubescent. Head adorned with 4 yellowish, feebly visible bands on the occiput; vertex sloping, feebly concave; frontal rostrum truncated, a little narrower than the first antennal segment. Face brown, shining; clypeus spotted with yellow. Eyes a little lengthened dorsally and ventrally, narrowing downwards; ocelli very small, disposed as a triangle, the anterior one in the middle of the rostrum in the bottom of a small gutter. Antennae testaceous with a few small yellow rings. Palpi yellowish; maxillary palpi with fourth segment a little shorter than third, fifth equalling the third, rather narrow, feebly securiform with superior and apical margins almost regularly convex. Pronotum a little wider than long, narrowing feebly in front; anterior margin slightly convex, posterior margin a little sinuated; disk weakly convex, testaceous brown with a few yellow spots, chiefly along the anterior margin; lateral lobes concolorous with inferior margin convex, rounded angles. Abdomen brown above, yellowish beneath; subgenital plate large, with posterior margin truncated, angles rounded. Ovipositor slender with superior valves short, oval, rounded at apex, their inferior margin with 3 rounded teeth, their external face finely tuberculated with a strong ridge before the apex; inferior apical valves much longer than the superior, bidentate at apex and with a tooth before the basal furrow. Legs rather short, pubescent. Anterior and median femora pale brown with yellowish base and three feebly distinct bands of the same colour; tibiae brownish with two rows of 3 or 4 yellow spots on the

superior face; anterior tibiae with two oval tympana; metatarsi very short. Posterior femora yellowish with two wide transverse brown bands, apex also darkened. Elytra brown, finely pubescent, with a series of irregular yellow spots along the humeral edge; transverse veinlets yellow, particularly near the base; veins almost longitudinal and equidistant; Cu divided near the apical third, its internal branch divided at base; An and two Ax regularly distant; transverse veinlets rather numerous, forming rather long areolae; lateral field with Sc giving off two longitudinal branches, rising very near the base. Wings feebly surpassing the elytra.

♂ *Allotype.* Very similar to the female; head darker without light bands on the occiput. Subgenital plate very long, very narrow at apex, covered with long hairs.

Length of body 12·5 mm.; length with wings 20 mm.; post. fem. 9·5 mm.; elytra 13·5 mm.; ovipositor 9 mm.

Types: N.E. Papua: Mt. Lamington, 1,300–1,500 ft. (C. T. McNamara), 1 ♀ (S.A.M.); Stephansort, Astrolabe Bay, Biro, 1897, 1 ♂ (Paris Mus.).

This species is very close to *M. javana* Sauss., with frontal rostrum narrowed and more regularly convex supero-apical margin of the fifth segment of maxillary palpi.

MUNDA QUADRIMACULATA sp. n.

♂ *Holotype.* Size medium; black with 4 callous yellow spots on the elytra. Head cubiform, black with scarce white hairs; frontal rostrum a little narrowing at apex, narrower than first antennal segment. Face dark brown, shining. Eyes very large, projecting, lengthened dorsally and ventrally; ocelli small, the anterior one in the middle of the rostrum. Antennae black. Maxillary palpi with first three segments dark brown, fourth shorter than third, widening, yellowish brown, fifth large, securiform, yellowish. Pronotum rather strongly narrowing in front, as long as wide in front, with anterior margin almost straight, sinuate, posterior margin yellow; disk irregularly convex, blackish, feebly punctate and pubescent; lateral lobes higher than long, black with yellowish inferior margin, angles rounded. Abdomen black above, yellow beneath, except the subgenital plate, which is brown. Cerci rather thick, brown with a wide yellow ring near the base. Elytra dark brown with whitish extremity, finely pubescent, with two large callous yellow spots on the humeral edge, near the base, and two other such spots near the middle; veins almost longitudinal, equidistant; transverse veinlets few in number; lateral field black with almost straight veins, Sc with 3 branches; surface between the veins finely striated. Wings long, slightly irridescent. Legs blackish with a

yellow spot at apex of the femora; anterior tibiae strongly swollen, perforated with two large, oval tympana. Posterior femora with a large, basal spot, yellow striated with brown on the external face; a little before the apex, there is an oblique yellow spot covering both external and internal faces.

♀ *Allotype.* A little larger than the male, general colouration lighter, pronotum feebly spotted with rufous. Subgenital plate feebly notched at apex. Ovipositor rather long, a little curved upwards; apical valves almost rounded, with tuberculated external face, with 3 small teeth towards the apex of the inferior margin.

Length of body ♂ 9 mm., ♀ 11 mm.; length with wings ♂ 13 mm., ♀ 15·5 mm.; post. fem. ♂ 5·7 mm., ♀ 7·2 mm.; elytra ♂ 9 mm., ♀ 10·5 mm.; ovipositor 7·5 mm.

Types: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂, 1 ♀ (S.A.M.).

This species is a little more slender than the preceding and very easy to recognize by its colouration.

MUNDA PUNCTATA sp. n.

♂ *Holotype.* Rather long and narrow; shining dark brown with head, pronotum and legs rather strongly punctate. Head flattened above, vertex and frontal rostrum very strongly punctate; frontal rostrum triangular with very narrow, but rounded top. Face as long as wide, rufous brown, shining. Maxillary palpi yellowish brown, with fourth segment short, fifth rather large and wide, securiform. Eyes big and projecting; ocelli very small. Pronotum narrowing rather strongly in front, with anterior margin straight, posterior margin subangulate; disk feebly convex, furrowed on the median line, shining, finely punctate; lateral lobes long, with slightly convex inferior margin, angles rounded, colour and punctuation as on the disk. Abdomen light brown above, yellowish beneath. Subgenital plate long, narrowing and rounded at apex. Genitalia with superior part deeply notched at apex and a tooth between the sides of the notch; inferior part formed of two acute points turned inwards. Anterior and median legs a little lighter than the body; anterior tibiae strongly swollen, perforated with a large oval tympanum either side. Elytra a little longer than the abdomen, rather narrow; veins longitudinal and equidistant; transverse veinlets scarce, forming very long areolae; lateral field low with close, longitudinal veins; Sc giving off one branch only rising from the base. Wings extending a little farther than the elytra, brown.

♀ *Allotype.* Similar to the male; general colour a little lighter, the head and pronotum tinged with rufous, femora rather strongly darkened; frontal

rostrum not so narrow at apex and not so coarsely punctuated. Posterior femora short and thick, with a rather strong punctuation, forming oblique streaks on the external face; metatarsi short with a large denticle before the apical spur on each superior margin. Subgenital plate with rounded posterior margin. Ovipositor rather long, a little curved; supero-apical valves rounded, rather strongly tuberculated and armed with 2 inferior teeth; inferior valves longer than the superior ones, denticulated.

Length of body ♂ 9 mm., ♀ 11 mm.; length with wings ♂ 12·5 mm., ♀ 15 mm.; elytra ♂ 8·5 mm., ♀ 10·5 mm.; post. fem. ♀ 6 mm.; ovipositor 10·5 mm.

Types: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂, 1 ♀ (A.M.).

This species has almost exactly the same aspect, colour, punctation and shape of the vertex as *Gryllaphonus striatipennis* but with a less close elytral venation and with anterior tibiae perforated with two large tympana.

MUNDA BASIMACULATA sp. n.

♂ *Holotype.* Size medium, rather wide; colouration brown with a large whitish spot at base of the elytra. Head cubical, brownish with 6 short yellowish lines on the occiput; vertex flat; frontal rostrum with rather strongly converging sides, apex truncated, much narrower than the first antennal segment. Face shining brown with darker spots on the facial shield along the margins of the clypeus and of the antennal sockets (in the paratype, the face is wholly black). Eyes large, rounded; ocelli rather large, almost equal, the anterior in the middle of the rostrum. Antennae light brown with a few small yellow rings, the first two segments brown, the first with a longitudinal yellow line in the middle above. Palpi yellowish with a slight brown tinge above; fourth segment of the maxillary palpi shorter than third, fifth equalling third, rather narrow, feebly securiform. Pronotum one and a quarter as wide as long, with straight anterior margin, posterior sinuate; disk rather strongly convex, uniformly rufous brown, pubescent; anterior and median femora with a few light spots; anterior tibiae perforated with two oval tympana. Posterior femora rather short and thick, a little darkened at apex, their external face striated and with a vague brown, transverse median band; posterior tibiae strongly hairy, armed with 4 spines on each margin; metatarsi very short. Elytra a little longer than the abdomen, rather wide, finely pubescent; their colour a light brown with a large basal whitish spot and another spot of the same colour about the middle on the humeral edge; dorsal field with 6 feebly oblique, very regularly separated veins; lateral field high, of the same colour as the dorsal field; Sc with 3 branches. Wings a little longer than the elytra.

♀ *Allotype.* As the male but a little larger. Subgenital plate wide, rather widely notched at apex. Ovipositor rather long, straight, with apical valves small, oblong, the superior ones rugulous, with 2 wide, rounded inferior teeth, the inferior valves denticulate, not surpassing the superior ones.

Length of body ♂ 12·5 mm., ♀ 15·5 mm.; length with wings ♂ 18·5 mm., ♀ 22 mm.; post. fem. ♂ 8·6 mm., ♀ 10 mm.; elytra ♂ 12 mm., ♀ 15·5 mm.; ovipositor 10·2 mm.

Types: New Guinea: Erinna, Astrolabe Bay (Biro, 1896), 1 ♂, 1 ♀ (Paris Mus.); Paratype: British New Guinea: Koitaki (E. A. Packley, 5–12, v, 1921), 1 ♂ (A.M.).

This species has the same general shape as *M. javana* (Sauss.) but with a different colouration.

MUNDA MELANOCEPHALA sp. n.

♂ *Holotype.* Rather small and slender; light brown with head nearly black. Head short, rather strongly flattened between the eyes; frontal rostrum with strongly converging sides, very narrow at apex. Face short, blackish, shining. Eyes big, projecting; ocelli very small, the anterior one scarcely visible in the bottom of a gutter at base of rostrum. Antennae broken, the first two segments brown, base of the flagellum yellow. Palpi yellowish; fourth segment of the maxillary palpi short, fifth rather wide, securiform. Pronotum light brown, with anterior margin straight, yellowish, a little thickened; posterior margin sinuate, also lighter than the disk; lateral lobes long, with inferior margin almost straight, very dark brown except for the light margins. Abdomen brownish above, yellowish beneath; subgenital plate long, narrowing, subangulate at apex. Cerci yellowish. Anterior and median femora yellowish; tibiae darkened on the superior face; anterior tibiae perforated with two oval tympana, the internal one very large. Posterior legs wanting. Elytra rather narrow, light brown above, with very dark sides; dorsal field with 5 oblique, regularly spaced veins; Sc with 2 branches, rising from the base.

♀ *Allotype.* Similar to the male but a little less slender; head and lateral field of the elytra not so dark. Ovipositor rather long and slender; apical valves oval, finely ridged on their external face, apex with 2 rounded teeth.

Length of body ♂ 8 mm., ♀ 9 mm.; length with wings ♂ 13 mm., ♀ 15·5 mm.; elytra ♂ 8·5 mm., ♀ 10 mm.; ovipositor 7·5 mm.

Types: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂, 1 ♀ (S.A.M.)

MUNDA FLAVOLINEATA sp. n.

♂ *Holotype.* Size medium; shape rather long. Head short; frontal rostrum with strongly converging margins, very narrow at apex, scarcely half as wide as the first antennal segment; head blackish above with a wide yellow band between the eyes, on the occiput; another yellow band, V-shaped, on the frontal rostrum. Eyes big, projecting; ocelli small, the anterior one in the bottom of a depression, in the middle of the rostrum. Face black, shining. Antennae rufous with first two segments blackish. Palpi yellowish; fourth segment of maxillary palpi short, fifth large, securiform. Pronotum one and a fifth times as wide as long, very feebly narrowing in front; anterior margin weakly convex, posterior margin sinuate; disk yellowish, darkened along the posterior margin; lateral lobes long, yellow. Abdomen brown above, yellow on the sides and beneath. Subgenital plate long, rounded at apex. Cerci yellow. Genitalia short, deeply notched at apex. Anterior and median legs yellowish with tibiae darkened above; anterior tibiae perforated with two tympana. Posterior legs wanting. Elytra finely pubescent, dark brown above with a yellow band on the humeral edge; veins almost longitudinal, very regularly spaced; lateral field brown, Sc with 2 branches rising from the base. Wings longer than the elytra.

Length of body 11 mm.; length with wings 16 mm.; elytra 10 mm.

Type: N.E. Papua: Mt. Lamington Distr. (C. T. McNamara), 1 ♂ (A.M.).

This species is close to *M. javana* (Sauss) but more slender. The colouration is rather characteristic, particularly on the head, but it must be very variable, as in all the species of this group. I have seen three specimens of the species, one of which is darker than the type with head and pronotum almost black, elytra of which is darker than the type with head and pronotum almost black, elytra very dark with a well defined humeral yellow band and a basal spot of the same colour divided by small black veins.

APHONOIDES BICOLOR sp. n.

♂ *Holotype.* Rather slender; head and pronotum rufous, elytra very dark brown. Head a little flattened; frontal rostrum as wide as first antennal segment. Eyes feebly projecting; ocelli small. Antennae and palpi rufous; fifth segment of the maxillary palpi short, securiform. Pronotum much wider than long, with posterior margin sinuated, wholly rufous; disk feebly convex, pubescent. Abdomen brownish above, rufous beneath; subgenital plate rather long, subacute at apex. Legs rufous; anterior tibiae rather strongly dilated at base, perforated with a large oval tympanum on the internal face;

posterior femora relatively long and slender. Elytra long, dark brown above, yellowish on the lateral field; dorsal field finely pubescent, with 7 regularly spaced, feebly oblique veins; 4 of these veins are branches of Cu; transverse veinlets rather regular, forming lengthened areolae; lateral field rather low; Sc with 8 branches which are regularly disposed along the whole length. Wings feebly surpassing the elytra.

Length of body 11 mm.; length with wings 17 mm.; post. fem. 8·5 mm.; elytra 13 mm.

Type: N.E. Papua: Mt. Lamington (C. T. McNamara), 1 ♂ (S.A.M.).

This species has rather characteristic colouration; it differs from most of the species of the genus *Aphonoides* in the shape of the fifth segment of the maxillary palpi which is short, subsecuriform.

PHISIS BREVIPENNIS sp. n. (Tettigonioidea, Conocephalidae).

♂ *Holotype.* Rather small, greenish. Head rounded, smooth; vertex ending in a sharp point. Face long; forehead large, smooth, feebly convex. Eyes strongly projecting, rounded. Antennae and palpi yellowish. Maxillary palpi long and slender, with fifth segment longer than fourth, feebly enlarged and obliquely truncated at apex. Pronotum a little depressed with truncated anterior margin, posterior convex; disk with two feebly marked longitudinal yellow bands and a deep furrow towards the anterior fourth; lateral lobes very low with straight inferior margin, rounded angles. Abdomen feebly compressed; tenth tergite convex, with posterior margin roundly notched in the middle; epiproct very small; paraprocts vertically lengthened with rounded superior margin. Subgenital plate narrowing backwards, feebly notched; no styles. Cerci curved, strongly enlarged at base, very narrow in the middle, again widening and depressed in their apical half. Legs long and slender, of the same colour as the body. Anterior femora armed on their inferior margins with 5 external, 4 internal very long spines; genicular lobes with a small spine; tibiae armed with 7 spines on each inferior margin, the three apical of which decrease in length; tympana in the shape of a split with strongly dilated margins. Middle femora with 3 external spines, and 1 internal spine at base; tibiae armed above with 2 internal spines, beneath with 5 internal and 6 external spines. Posterior femora strongly dilated at base but with a long, filiform, apical part; infero-external margin with 6 small spines in the apical half, internal margin without spines; genicular lobes armed with a small spine; posterior tibiae long and slender, armed above with 18–20 spines on each margin, beneath with 12 external, 7 or 8 internal spines. Elytra very narrow,

extending only little beyond the abdominal extremity; anterior margin sinuated, posterior margin straight; Sc and R veins very close, a little sinuated; M and Cu shortly united at base, the median vein straight; transverse veinlets rather numerous and regular. Wings as long as the elytra.

♀ *Allotype.* Similar to the male. Elytra very narrow, subacute at apex, with longitudianl veins; M and Cu united rather lengthily at base. Ninth abdominal tergite large, feebly dilated, with concave posterior margin; tenth short, deeply notched at apex. Cerci close at base, a little depressed, slightly curved. Subgenital plate narrowing and feebly notched at apex. Ovipositor long, compressed, straight as far as the middle, rather strongly curved after; superior valves strongly dilated at base.

Length of body ♂ 12 mm., ♀ 16 mm.; pronot. ♂ 3 mm., ♀ 3·5 mm ; ant. fem. ♂ 6·5 mm., ♀ 6·8 mm.; post. fem. ♂ 11 mm., ♀ 11·5 mm.; post. tib. ♂ 12·2 mm., ♀ 13·6 mm.; elytra ♂ 11 mm., ♀ 13·5 mm.; ovipositor 9 mm.

Types: Dunk Island (H. Hacker, Aug. 1927), 1 ♂, 1 ♀ (Q.M.).

This species is quite distinctive with its short elytra and can be compared only with *P. africana* Karny, from the Cameroons.

On THREE NEW GENERA and SPECIES of SCHIZOPTERINAE (Heteroptera-Cryptostemmatidae) from AUSTRALIA

By GORDON F. GROSS, South Australian Museum.

Fig. 1–2.

The minute bugs of the family Cryptostemmatidae are now known to have representatives of both subfamilies in the Australian fauna. The Cryptostemmatinae are as yet still represented by the one species *Ceratocombus* (*Xylonannus*) *australiensis* Gross (Gross, 1950), while the Schizopterinae are represented by a number of specimens in the collection of the South Australian Museum, and in a collection at present with Dr. P. Wygodzinsky in Tucumán, Argentina. The Australian Schizopterine material in the South Australian Museum collection contains a number of new genera and species, but of this material only three species (each belonging to a new genus) are represented by specimens in sufficiently good condition to merit their description. The description of the remainder awaits the acquisition of supplementary material.

To describe these new forms I have endeavoured to establish a more complete nomenclature for the main veins of the hemelytra than hitherto employed (Wygodzinsky, 1950, p. 11). The venation of *Pachyplagioides* gen. nov. (fig. 10) as one of the more simple among Schizopterinae and also more easily compared with the venation of certain other classic hepteropteron types (cf. the nymphal Coreid *Syromastes,* and the fossils *Dunstaniopsis* and *Prosbole*) is here described in detail.

In *Pachyplagioides* the thickened costal margin of the hemelytra is expanded around Sc, the second vein is R + M, dividing about one-third of the way along the hemelytron into R and M. R is two-branched, the external branch to Sc is R_{1+2} and the portion running posteriad to the hind margin is Rs. That the outward turning portion of the vein is R_{1+2}, rather than R, only, is best shown by comparing Wygodzinsky's figure of *Chinannus bierigi* (Wygodzinsky, 1948, fig. 15) with Tillyard's figure of *Dunstaniopsis triassica* (Tillyard, 1918, text fig. 18). The first division of R + M is into R_{1+2} and Rs + M. In both *Chinannus* and *Dunstaniopsis* R_{1+2} then continues for a little way as a composite vein before dividing into R_1 and R_2. Rs + M subsequently divides into Rs and M, and then Rs in both genera divides into R_3 and R_{4+5}, and it is R_{4+5} which in both genera receives the R — M cross vein.

M gives off a cross vein to Cu before the latter reaches the region of 1A + 2A (*vide infra*) which is doubtless the M — Cu cross vein of wide occurrence in insects, and then M receives another connection with Cu from the region of the junction of Cu and 1A + 2A. A comparison with *Syromastes* and *Dunstaniopsis* has led me to believe that this is the outward turning branch of Cu (Cu 1a?) which more or less follows the *dividing line* to meet elements of M. This is much better shown in Wygodzinsky's figure of *Humptatanannus addititius* (Wygodzinsky, 1950, fig. 192). M in *Pachyplagioides* after the junction with Cu turns outward, branching to send an outward element to join R at the division of R_1 and Rs (the R — M cross vein of wide occurrence in insects) and then turns inward to join Cu; this last very reminiscent of the formation of the larger membranal cell in Miroidea. Cu follows very close to the claval suture but exterior to it and receives M — Cu from, and gives off Cu_{1a} to M and also receives 1A + 2A then proceeds posteriad (as Cu_{1b} + Cu_2?) to join M just anterior to the posterior margin. 1A and 2A are separate over most of the clavus in *Pachyplagioides*, but fuse just in front of the claval suture in this genus and cross the suture as a composite vein 1A + 2A to join Cu.

The venation of all other Schizopterinae seems easily comparable with, though often more primitive than that of *Pachyplagioides*. R_{1+2} branches into its 2 component veins in *Chinannus* while in some other genera (e.g. *Ommatides, Schizoptera, Seabranannus*, etc.) R_1 and R_2 are given off separately before Rs and M separate. A fairly constant feature appears to be the two cross veins connecting M and Cu (M—Cu and Cu_{1a}, and the usually rectangular cell enclosed by them (mc). Cu may not join with M to form the closed cell characteristic of *Pachyplagioides, Dictyonannus* gen. nov., *Humptatanannus, Vilhenannus, Tropistrochus*, etc., but continue to the apical margin as in *Pachyplagia*, or disappear without reaching the margin as in *Ceratocomboides, Schizoptera, Corixidea, Membracioides, Nannocoris, Dundonannus, Seabranannus, Humptatanannus*, etc., and in some of these genera no distinct 1A + 2A is formed, 1A and 2A join terminally without continuing on forming a single ring-shaped vein (*Ceratocomboides, Schizoptera*, etc.).

The Schizopterinae have long been recognized as an extremely archaic group within the Heteroptera on the peculiar structure of the antennae, the diversity of the venation, the almost complete lack of differentiation of the hemelytra into corium and membrane, the ill-defined clavus and claval suture, and in the somewhat arched hemelytra of some genera, e.g. *Dictyonannus* gen. nov., a character reminiscent of Homoptera. The brachypterous forms of Schizopterinae often show even more primitive features, e.g. the apparent complete lack of a clavus in many brachypterous forms.

In several genera there are vague indications of an incipient differentiation between corium and membrane on the hemelytra, for example in *Pachyplagioides* Cu_1a, M (after its junction with Cu_1a) and R_{1+2} all follow an oblique line reminiscent of the behaviour of these same vins along the *dividing*

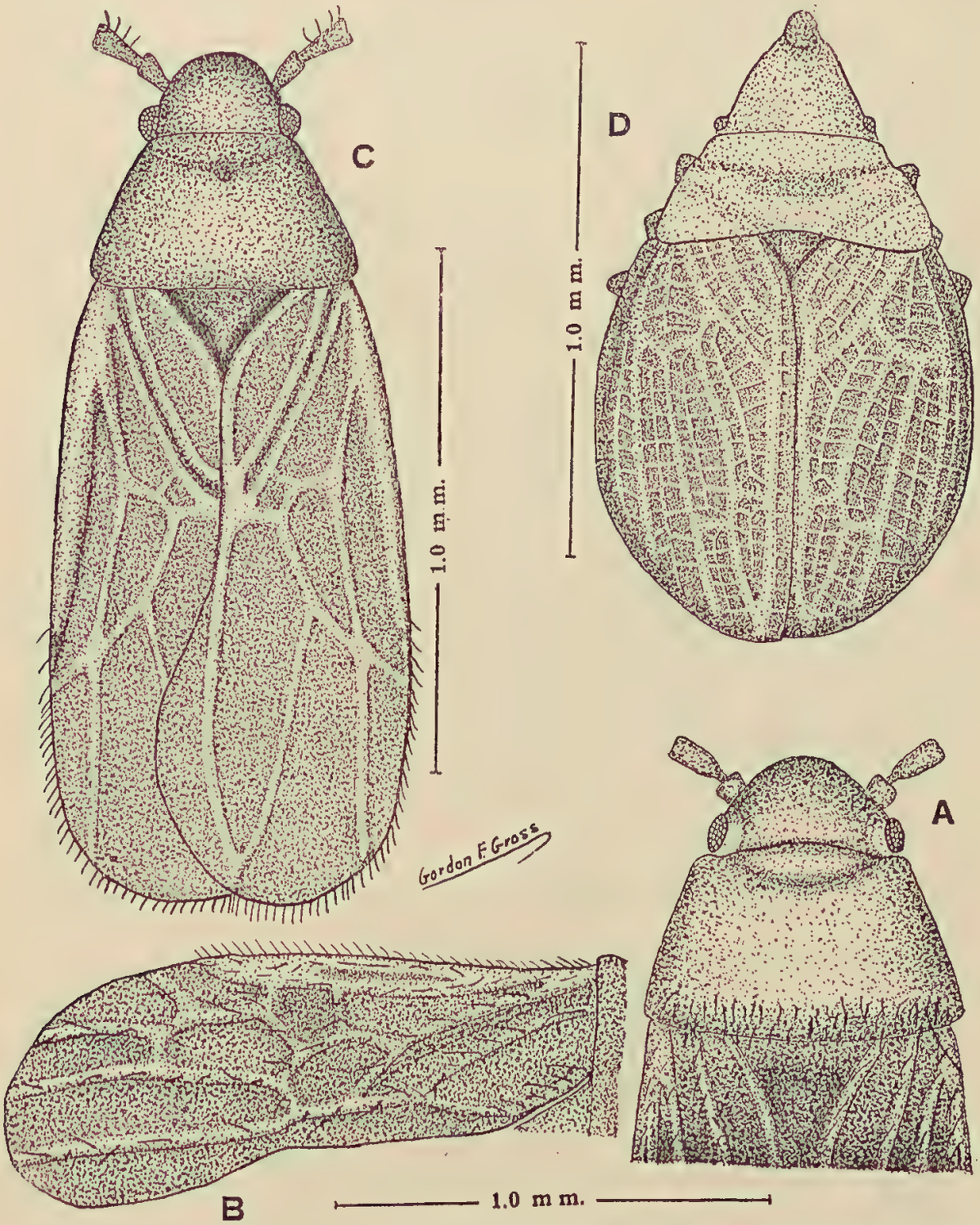

Fig. 1. A. dorsal view of head and pronotum and B of *Pachyplagia australia* n. sp. B. dorsal view left elytron. C. dorsal view *Pachyplagioides reginae* n. sp. D. dorsal view *Dictyonannus flavus*, n. sp.

line in the *Syromastes* nymph and in *Dunstaniopsis*, something the same thing occurs in *Dundonannus* and is best marked of all in *Humptatanannus addititius* (Wygodzinsky, 1950, fig. 192). Some forms (*Humptatanannus, Dundonannus, Vilhenannus, Corixidea* and *Membracioides*) have a well marked node on the costal margin, and such genera as *Pachyplagioides, Nannacoris* and *Humptatanannus* show a marked thickening of the costal margin (which affects only Sc in these genera but includes both Sc and R in *Pachyplagia*) a posterior spreading of which might be the method by which corium and subsequently clavus have become hardened and the venation obsolete in the more highly developed heteroptera.

The Schizopterinae seem to have separated from the main bulk of Heteroptera at about the stage of the Dunstaniidae; the wing venation of *Schizoptera* especially as regards M is much more simple than in Dunstaniidae, and can be more or less derived from that of this family. But an extremely puzzling complication arises here that many Schizopterine genera show no trace of a *dividing line,* a feature more primitive than *Dunstaniopsis.* There can only be two explanations for this, either the arrangement of veins in *Humptatanannus, Plachyplagioides,* etc. resembling a *dividing line* is purely accidental, and that the Schizopterinae separated from the stem of recent Heteroptera before the true *dividing line* appeared[1], or there has been an actual loss of the *dividing line* in those forms which show no trace of anything resembling it, e.g. *Dictyonannus,* in which case time of separation of the Schizopterinae from other Heteroptera is maybe much later and certainly occurred after the formation of a *dividing line* in Heteroptera.

My thanks are especially due to Mr. N. B. Tindale for considerable assistance in the elucidation of the wing venation of these forms.

The three new Australian forms may be distinguished with the following key:

1. Hemelytra with a fine "herringbone" sculpture between the main veins
Dictyonannus flavus gen. et. sp. nov.

   Hemelytra not as above 2

2. Cu_{1a} given off from Cu at the junction of Cu with 1A + 2A
Pachyplagioides reginae gen. et. sp. nov.

   Cu_{1a} given off from Cu well after the junction of Cu with 1A + 2A
Pachyplagia australia gen. et. sp. nov.

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[1]In some Tropiduchidae (Homoptora) e.g. *Ossa* spp. a structure analogous to the "dividing line" in modern Heteroptora occurs together with a well advanced differentiation of the tegmina into a "corium" and "membrane" in addition to the clavus. This similarity to the hemelytron of a Heteropteron is certainly accidental in this case.

PACHYPLAGIA gen. nov.

Shape elongate oval. Head and pronotum strongly declivous, hemelytra flat. Eyes moderate in size, several times smaller than the distance between them. Ocelli absent. Rostrum short, robust, attaining only midcoxae. Third segment of antennae longer than fourth.

Pronotum trapeziform, punctate, a distinct pronotal collar present. Lateral margins straight, anterior and posterior convex. Scutellum triangular extending well back under pronotum, this region exposed in some specimens and separated from region normally exposed by a transverse sulcus, this sulcus lying in specimens in which the rest of the scutellum is not exposed, just under hind margin of pronotum. Propleura enlarged, sac-like, produced forward to level of eyes, metapleura with a posterior lobe only. Metasternum with a longish backwardly directed spine.

Legs normal, tarsal formula 2.2.3. in both sexes. Claws long and curved. Arolia not conspicuous.

Hemelytra with well marked and developed venation (fig. 1B). Under special lighting the thickened costal margin is seen to be composed of Sc and R which are separated near the centre of this costal thickening by a short longitudinal groove. Cu along claval suture also only visible under special lighting. Cell mc hexagonal, Cu_{1a} given off after junction of Cu and 1A + 2A, M gives off three branches to R the most exterior R—M (to R_{4+5}). Rs (R_{3+4+5}) emerges from near end of thickened costal margin and divides into R_3 and R_{4+5}. 1A and 2A are separate over most of the clavus then merge into 1A + 2A which crosses the claval suture to join Cu. Cu_{1b} (+ Cu_2) continues straight to hind margin after Cu_{1a} is given off to M. Wings with a very fine net-like reticulate venation.

Male genitalia asymmetrical right clasper the largest, vesica long and slender and coiled, near anus a long apparently movable process reminiscent of a bovine tail which is probably the anophore (or possibly a third free appendage).

Female genitalia apparently symmetrical, without gonopophyses.

PACHYPLAGIA AUSTRALIA sp. nov.

Fig. 1 A, B, 2 A, B, C.

Holotype male *forma macroptera.*

Coloration. Pronotum, head, eyes, scutellum, thickened costal margin and underside of abdomen brown; legs, rostrum and antennae yellowish brown.

Structure. As for generic description. Head 360μ long, width across eyes 600μ, lengths of segments of antennae 80μ, 80μ, 430μ, 340μ, first two segments with short hairs (30μ), second pair with much longer hairs, one long, one near the base of segment IV being 280μ. Rostrum 240μ long, lengths of segments 60μ, 50μ, 110μ.

Pronotum 430μ long, anterior width 580μ, posterior width 620μ. Lengths of podomeres, femora I 420μ, II 460μ, III 540μ, tibiae I 530μ, II 460μ, III 700μ, tarsi and claws I 220μ, II 220μ, III 530μ.

Body covered with a sparse pilosity apparently absent in the cells of the hemelytra and on the wings. The longest hairs on the abdomen congregated around the pygophore (up to 90μ).

Total length 2000μ. Greatest width 620μ.

Allotype female *forma macroptera.*

As for male. Spermatheca as figured. Lengths podomeres femora I 440μ, II 480μ, III 560μ, tibiae I 470μ, III 720μ, tarsi and claws I 230μ, II 220μ, III 350μ, lengths segments antennae, 110μ, 80μ, 470μ, 370μ lengths segments rostrum 80μ, 60μ, 160μ.

Holotype ♂ and allotype ♀ from Sydney, N.S.W., H. W. Cox (Nos. I 20,053 and 20,054), 41 paratypes from Sydney, N.S.W., H. W. Cox and A. M. Lea, and Port Lincoln, S.A., A. M. Lea (inquilines), all specimens in the collection of the South Australian Museum (Nos. I 20,055 to I 20,061).

PACHYPLAGIOIDES gen. nov.

General form elongate oval. Head short, width across eyes greater than length. Eyes moderately larger, several times smaller than the distance separating them dorsally. Ocelli absent. Clypeus not salient. Rostrum just reaching mid-coxae. First two segments of antennae equal in length and together somewhat shorter than length of head, remaining segments ?

A distinct prenotal collar present, pronotum trapeziform, posteriorly wider than long, posterior margin almost straight, anterior slightly convex. Scutellum acuminate, length subequal to basal width. Meso- and metapleura normal, metapleura with slight angle posteriorly.

Legs moderately slender, all leg segments including coxae setose, tibia markedly so. Claws simple, arolia rounded. Tarsal formula 3.3.3.

Hemelytra with a well marked and developed venation (fig. 1C). Sc running only ⅔ of the costal margin which is strongly thickened, R + M is fused with Sc along its basal quarter, R + M divide about half along Sc, R divides only in two branches, R_{1+2} and R_{3+4+5}. Cell mc rectangular, Cu_{1a} given

off at point of fusion of 1A + 2A with Cu, Cu_{1b} and M merge distally, R—M meeting Rs (R_{3+4+5}) at point of separation of R_{1+2}. 1A and 2A separate over most of the clavus, uniting just before claval suture into 1A + 2A which crosses the suture to fuse with Cu.

Abdomen of male apparently strongly chitinized. Asymmetrical claspers present. Vesica short, robust.

PACHYPLAGIOIDES REGINA sp. nov.

Fig. 1 C, 2 D, E, F, G, H, I, J.

Holotype male *forma macroptera.*

Colouration. Dark chestnut brown; legs, first two segments of antennae and rostrum yellowish and hemelytra yellowish, infuscated.

Structure. As for generic description. Head 250μ long, width across eyes 260μ, width across eyes 260μ. First 2 segments of antennae as in figure (2 I) each 95μ long, remaining segments missing. Rostrum stout, total length 220μ and width at base 60μ.

Pronotum dimensions: anterior width 370μ, posterior width 530μ, length 410μ, lateral margins with fine hairs. Scutellum punctate, width at base 170μ and length 160μ.

Femora normal, sparsely setose, tibiae slender, hind tibiae slightly curved. Tibiae more setose than femora with longish spines (up to 130μ) on their outer margin and much denser and generally shorter (50μ) pairs on their inner margins. Coxae with sparse and longish (100μ) hairs near articulation with femora. Dimensions of podomeres: femora I 410μ, II 430μ, III 430μ; tibiae I 430μ, II 410μ, III 620μ; tarsi and claws I 160μ, II 160μ, III 230μ.

Veins of hemelytra with scattered hairs up to 30μ long, costal margin with longer hairs (95μ) beginning near the end of Sc, and passing around the posterior end of wing longest posteriorly.

Ventral abdominal segments (except genitalia) without appendages with sparse hairs (up to 80μ) and a clothing of extremely short hairs (only several μ long).

Male genitalia as figured.

Total length: 1640μ. Greatest width: 620μ.

Holotype male from "Fallen leaves, Cairns District, Queensland, A. M. Lea," in the collection of the South Australian Museum (No. I 20,052).

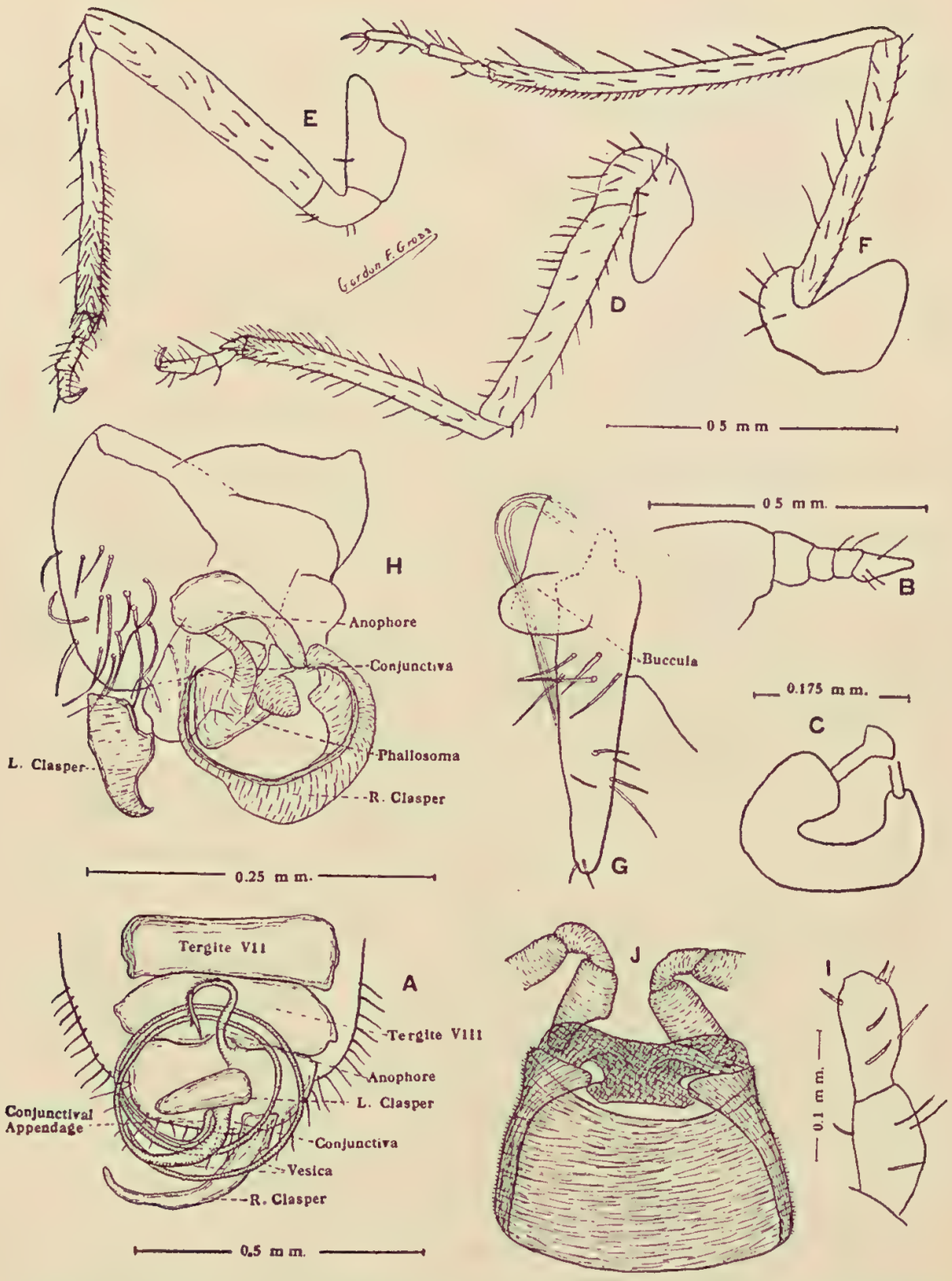

Fig. 2. A. dorsal view male genitalia. B. rostrum and C. spermatheca of *Pachyplagia australia*. D. fore leg. E. second leg. F. hind leg. G. rostrum. H. male genitalia from above. I. first two segments of antennae and J. Prosternum of *Pachyplagioides reginae* n. sp.

DICTYONANNUS gen. nov.

Shape broadly pear-shaped. Head conical, clypeus very slightly salient. Eyes very small, ocelli absent. Head beneath sulcate from just behind rostrum to anterior margin of prosternum. Antennae inserted ventrally very close to the raised edges of the sulcus. First two segments only present, remainder apparently lost. Rostrum reaching to about mid-coxae. First segment incrassated, second longer than first, and third longer than first two together.

Anterior margin of pronotum nearly straight, posterior margin concave, lateral margins straight, diverging posteriad, hind angles rounded; pronotum nearly twice as broad as long, subequal in length to head. Pronotum dorsally with a curved transverse constriction. Prosternum and mesosternum showing a continuation of the ventral sulcus of the head; on hind margin of mesosternum this rises and becomes a nearly horizontal backwardly produced spathulate spine. This sulcus has a raised keel on either side. Propleura pouch-like in which are inserted the fore coxae, propleura produced well in front of eyes. Metapleura not produced back in spine but only as a lobe. Scutellum triangular.

Femora of all three legs subequal, tibia I and II shortest and tibia III longest; tarsi I, II and III subequal. Tarsal formula 2.1.1.

Elytra very convex and very coriaceous costal margin broadly reflexed, turning outwards before doing so to form (looking from above), a kind of gutter. Venation as figured (fig. 1D), with a fine herringbone sculpture between the main veins. Sc not discernible but apparently following the costal margin. R_{1+2} and Rs undivided. Cell mc long, anterior margin (M) sinuate Cu_{1a} meeting M $\frac{2}{3}$ the length of hemelytron and well past the fusion of 1A + 2A and Cu, Cu_{1b} + Cu_2 joins M before posterior margin. R—M cross vein a little further exterior in position to Cu_{1a}; 1A and 2A separate over most of the clavus uniting just anterior to the claval suture into 1A + 2A and crossing the suture to fuse with Cu. Ventral abdominal segments strongly chitinized. No asymmetrical gonopophyses present in female genitalia.

DICTYONANNUS FLAVUS sp. nov.

Fig. 1 D.

Holotype male.

Colouration. Honey coloured. Eyes red.

Structure. As for generic description. Length of head 170μ, width across eyes 300μ, lengths 2 segments of antennae present 40μ and 60μ, second segment

only with a few sparse hairs (20μ). Rostrum 510μ long, lengths of segments 60μ, 110μ, 340μ.

Pronotum 250μ long, anterior width 260μ, posterior width 450μ. Lengths podomeres, femora I 230μ, II 230μ, III 250μ, tibiae I 28μ, II 260μ, III 330μ, tarsi and claws I 160μ, II 160μ, III 160μ. Scutellum 160μ long and 250μ wide basally. Hemelytra 780μ long. Ventral abdominal segments with sparse hairs, longest (35μ and subclavate) on the pygophore.

Total length: 1240μ. Greatest width 780μ.

Holotype female (Cairns District, 1 ♀, A. M. Lea, in fallen leaves, in the collection of the South Australian Museum (No. I 29,062)).

BIBLIOGRAPHY.

China, W. E., 1946; New Cryptostemmatidae (Hemiptera) from Trinidad, British West Indies. *Proc. R. Ent. Soc. London* (B), 15 (11–12); 148–154, 5 figs.

Gross, G. F., 1950: On a New Species of Cryptostemmatidae (Hemiptera-Heteroptera) from Australia. *Rec. South Aust. Mus.*, 9 (3): 327–9, 1 fig.

Handlirsch, A., 1908: Die Fossilen Insekten, etc. Leipzig. Pls. 7, 37, 38, 43.

Reuter, O. M., 1891: Monographia Ceratocombidarum Orbis Terrestris. *Act. Soc. Sci. Fenn.*, 19 (6): 27 pp., 1 pl.

McAtee, W. L. and Malloch, J. R., 1925: Revision of bugs of the family Cryptostemmatidae in the collection of the United States National Museum. *Proc. U.S. Nat. Mus.*, 67 (13): 1–42, 4 pls.

Tillyard, R. J., 1918: Mesozoic Insects of Queensland. No. 4. (Hemiptera, Heteroptera). The Family Dunstaniidae. With a Note on the Origin of the Heteroptera. *Proc. Linn. Soc. N.S.W.*, 43 (3): 568–592, 1 Pl., 5 figs.

Wygodzinsky, P., 1947: Sobre um novo genero e uma nova especie de Schizopterinae do Brasil (Cryptostemmatidae, Hemiptera). *Bol. Ent. Venezolana, Caracas,* 6 (1): 25–35, 17 figs.

Wygodzinsky, P., 1950: Schizopterinae from Angola (Cryptostemmatidae, Hemiptera). ex. Subsidios para o Estudo da Biologia na Lunda. Published by the Museu do Dundo (Lisboa).

The SOUTH AUSTRALIAN REPTILE FAUNA

Part I. OPHIDIA

By FRANCIS J. MITCHELL, South Australian Museum.

Fig. 1–3.

This systematic list of the South Australian Reptile Fauna contains comments on the variation and distribution of various species within the State. Three snakes are described as new. All species and races added since or omitted by Waite (1929) are marked with an asterisk.

Family TYPHLOPIDAE.

Typhlops unguirostris Peters.

Typhlops (*Onychocephalus*) *unguirostris* Peters, 1867, Monats. Akad. Berlin, p. 708, fig. 3.

Typhlops pinguis Waite.

Typhlops pinguis Waite, 1897, Trans. Roy. Soc. S. Austr., xxi, p. 25, pl. III.

Typhlops bituberculatus (Peters).

Onychocephalus bituberculatus Peters, 1863 (1864), Monats. Akad. Berlin, p. 233.

Typhlops australis (Gray).

Anilios australis Gray, 1845, Cat. Liz. Brit. Mus., p. 135.

Family BOIDAE.

Morelia argus variegata Gray.

Morelia variegata Gray, 1842, Zool. Misc., p. 43.

Loveridge (1934, p. 270) has summarized the reasons for the recognition of *argus*, and the resurrection of *Morelia*. Further, he expresses the opinion that the two colour phases are dimorphic forms and consequently considers *variegata* synonymous with typical *argus*. However, constant populations of

both phases undoubtedly occur, all South Australian specimens so far examined being referable to *variegata,* and it is the author's opinion that *variegata* should be retained until sufficient material is available to thoroughly analyse the problem.

ASPIDITES MELANOCEPHALUS RAMSAYI Macleay.

Aspidiotes ramsayi Macleay, 1882, Proc. Linn. Soc. New South Wales, 6, p. 813.

FAMILY ELAPIDAE.

ASPIDOMORPHUS DIADEMA (Schlegel).

Calamaria diadema Schlegel, 1837, Phys. Serp., 2, p. 32.

DEMANSIA PSAMMOPHIS PSAMMOPHIS (Schlegel)

Elaps psammophis Schlegel, 1837, Phys. Serp., 2, p. 455.

This species is fairly abundant in the drier regions of the State.

DEMANSIA TEXTILIS (Dumeril and Bibron).

Furina textilis Dumeril and Bibron, 1854, Erp. Gen., 7, p. 1,242.

South Australian examples of the species vary considerably in scalation and colouration. Specimens collected in the drier regions of the State differ from more southerly examples in possessing a larger, more prominent rostral and in showing a greater tendency to retain the darker juvenile markings in the adult. Eastern Australian juveniles, presumed to belong to the type race, the type locality being unknown, often possess as many as 50 narrow black cross-bands. A minority of both adult and juvenile specimens examined from Central and Northern South Australian localities possess 12 or less broad black bands, the bands being present only on the anterior half of the body in several adult specimens. Other adults are uniform light brown often with occasional black scales or faint variegations. None of the many specimens examined from the vicinity of Adelaide and other localities to the south were found to possess darker body markings, although a black nape and head bands are invariably present in young specimens.

Loveridge (1934, p. 278) places a specimen taken at a locality on the Coorong, South Australia with three New South Wales specimens in the type race. In view of this decision all specimens with the less prominent rostral and uniform adult colouration, whose distribtuion appears to be correlated with the

cooler climate, are herein regarded as belonging to *D. textilis textilis,* while those taken further north are referred to *D. textilis nuchalis,* although they are by no means typical of North-western Australian populations of the subspecies.

The following South Australian specimens were examined. *D. textilis textilis*: Adelaide and suburbs (27 specimens), Tailem Bend (2 specimens), Snowtown, Yorketown, Clarendon, Hallett's Cove, Hindmarsh Island, Murray Bridge (2 specimens), Naracoorte, Strathalbyn, Crafers, Nortons Summit, Ardrossan, Port Pirie, Wallaroo (2 specimens), Kangarilla, Millbrook, Hectorville, Angaston, Salisbury (2 specimens), Tanunda, Lucindale (2 specimens), Milang, Blackwood, Waterfall Gully, Marino, Williamstown, Echunga, Happy Valley, Port Lincoln (2 specimens), Middleton, Hackham, Wardang Island, Narrung, Encounter Bay.

D. textilis nuchalis: Ooldea (3 specimens), Penong (3 specimens), Streaky Bay, Marree (3 specimens), Kingoonya, Bordertown, Koonibba (3 specimens), Burra, Mern Merna (8 specimens), Hawker, Renmark, Mingary, Lake Eyre South (on south-eastern shore), Wharminga, Whyalla.

The position of the 2nd and 3rd upper labials relative to the preocular and the number of lower labials contacting the anterior chin-shields are very variable, the variation being independent of distribution.

The variety *inframacula* Waite occurs spasmodically and is not worthy of taxonomic recognition.

*Demansia modesta (Gunther).

Cacophis modesta Gunther, 1872, Ann. and Mag. Nat. Hist., (4), 9, p. 35, pl. III, fig. C.

A number of specimens belonging to this species have been taken in the North-western corner of the State in the Mann, Everard and Barrow Ranges.

*Demansia acutirostris sp. nov. (Fig. 1).

Holotype. S.A.M. R.3133, taken at lat. 28.26′ S. and long. 137.24′ E. on an island in Lake Eyre, South Australia. The specimen was taken in October, 1950, by Messrs. E. A. Brooks, M. Brooks and E. Price, while conducting a tour over the recently filled lake.

Diagnosis. Midbody scales in 17 rows; anal divided; ventrals 218; subcaudals in 55 pairs. Snout strongly depressed; lower jaw undershot by a distance almost equal to half the snout length. Uniform brown above with several broad darker cross-bands.

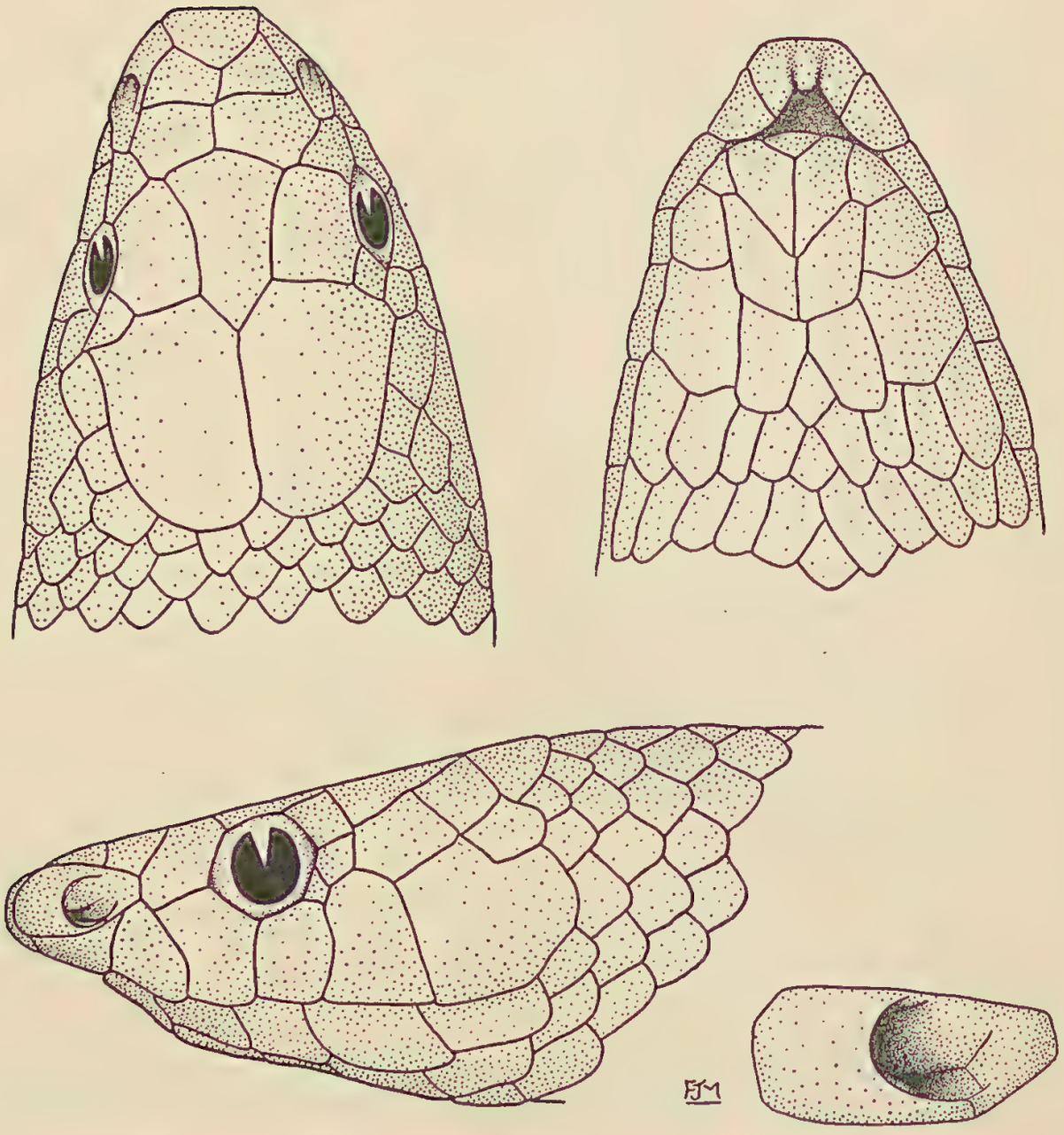

Fig. 1. *Demansia acutirostris* Mitchell. Dorsal, lateral and ventral views of the head of the holotype specimen; an enlarged view of the valvular nostril is also shown.

Type description. Eye moderate, its diameter a little longer than its distance from the mouth. Snout strongly depressed, square fronted, with a flat dorsal surface; lower jaw undershot by a distance almost equal to half the snout length; the portion of the rostral visible dorsally is much wider than long.

Frontal widest anteriorly, $1\frac{1}{2}\times$ wider than long, wider than the supraoculars, but constricted to a width slightly less than the supraoculars (see fig. 1). Nasal large, undivided, in contact with the preocular; nostril valvular, the

nasal depression being large, but the actual aperture only a slit between three fleshy pads. Postoculars irregular, three on the left, the lower minute, two on the right; a single preocular. Temporals 1 + 2, the lower posterior set into the upper edge of the sixth upper labial; third and fourth of six upper labials subocular. First upper labial curving well in under the snout. Midbody scales in 17 rows; ventral 218; subcaudals 55; anal divided.

The fangs are followed after a short intersparce by six or seven strongly grooved teeth; slightly recurved.

Dorsal surfaces light brown with several darker cross-bands of varying width. These bands are only faintly visible in the preserved specimen, but were prominent in life. The brown dorsal colouring extends well under the body to the ventrals, leaving a mid-ventral white stripe approximately one-third the total width of a ventral scale.

Measurements: 1,045 (900 + 145) mm.

This species is separable from all described members of the genus by the strongly depressed snout, markedly undershot lower jaw and greater development of the valvular nostril. In most species of *Demansia* there is a tendency for the nostril to be partially closed by a series of dermal folds, but in none is it developed to the extent shown in *acutirostris*.

The flat dorsal surface of the square tipped snout, the undershot lower jaw and valvular nostril suggest that this species is of burrowing habit. Its general appearance and colouration are most nearly approached by *D. textilis nuchalis* (Gunther).

PSEUDECHIS PORPHYRAICUS (Shaw).

Coluber porphyraicus Shaw, 1794, New Holland, p. 27, pl. X.

PSEUDECHIS AUSTRALIS (Gray).

Naja australis Gray, 1942, Zool. Miscell., p. 55.

PSEUDECHIS MICROLEPIDOTUS (McCoy).

Diemenia microlepidotus McCoy, 1879, Prod. Zool. Vict., dec. III, pl. xxiii, fig. 2–3.

I have been unable to find a confirmed record of this species occurring in South Australia, although its recorded distribution in Northern Victoria and South-western New South Wales indicates that it may occur in parts of Eastern South Australia.

DENISONIA SUPERBA (Gunther).

Hoplocephalus superbus Gunther (part), 1858, Cat. Snakes Brit. Mus., p. 217.

Waite (1929, p. 218) doubtfully included this species in his handbook, mentioning that he had not seen "an undoubted example" from South Australia. Recently, numerous examples have been received from localities in the upper Mount Lofty Ranges and the lower south-eastern districts of South Australia. A single juvenile specimen from Kangaroo Island has also been examined.

DENISONIA CORONATA (Schlegel).

Elaps coronatus Schlegel, 1837, Phys. Serp., 2, p. 454.

Two South Australian specimens of this species, S.A.M. R.1777 and R.2134, have been examined. Both were taken at Mount Compass.

DENISONIA CORONOIDES (Gunther).

Hoplocephalus coronoides Gunther, 1858, Cat. Snakes Brit. Mus., p. 215.

All South Australian examples examined belong to the *marstersi* colour variety.

*DENISONIA NIGROSTRIATA BREVICAUDA subsp. nov.

Holotype. S.A.M. R.3137, Fowler's Bay, South Australia.

Paratypes. S.A.M. R.1230, Waikerie, South Australia; S.A.M. R.2273, Parrakie, South Australia; S.A.M. R.3136, nine adults and twelve juveniles taken at Sedan in the Murray Scrub, South Australia; S.A.M. R.3138, R.3140, Murray Bridge, South Australia; S.A.M. R.3141, Mount Wedge, *via* Elliston, South Australia and R.3139, Beetaloo Waterworks, South Australia.

Diagnosis. As the subspecific name suggests, South Australian examples of this species differ from the type race in possessing a much shorter tail with consequent decrease in the number of subcaudal scales. The holotype of *D. nigrostriata nigrostriata* possessed 62, while Boulenger (1896, p. 344) records 50–64; Kinghorn (1929, p. 182) records the species as extending well down into New South Wales, but does not record any additional data, merely quoting Boulenger's variation. Kershaw (1918, p. 31) records the occurrence of the species in Victoria and National Museum locality records indicate the species to be restricted to the north-western corner of that State. The subcaudal scale counts of the fourteen adults in the present series vary from 23–29, the mean being 26·1. The ventral scale count is also lower, being 152–164 as compared to 180–

184 (Boulenger, op. cit.). In all other scale details these specimens agree closely with the type race.

The holotype is the largest specimen examined and measures 455 (415 + 50) mm. It is interesting to compare these measurements with those of Boulenger's type race topotype, viz. 380 (328 + 52) mm.

DENISONIA GOULDII (Gray).

Elaps gouldii Gray, 1841, in Grey's Journ. Exped. West. Austr., 2, p. 444, pl. V, fig. 1.

DENISONIA FLAGELLUM (McCoy).

Hoplocephalus flagellum McCoy, 1878 (decade II), Prod. Zool. Vict., p. 7, pl. XI, fig. 1.

This species is common in the Mount Lofty Ranges, South Australia.

DENISONIA SUTA (Peters).

Hoplocephalus sutus Peters, 1863, Monatsb. Akad. Berlin, p. 234.

In two excellent papers Kinghorn (1920 and 1929) has compiled sound reasons for synonymizing *H. frenatus* Peters, *H. frontalis* Ogilby, *H. stirlingi* Lucas and Frost, *D. frontalis* var. *propinqua* De Vis and *D. forresti* Boulenger with *suta*.

The following data on South Australian specimens has been compiled as a supplement to Kinghorn's 1920 paper on Eastern Australian material.

S.A.M. R.130, Quorn, 157, 35; S.A.M. R.2628, Mern Merna (2 specimens), 176, 32; 164, 33; S.A.M. R.2658, Mern Merna, 163, 35; S.A.M., R.2781, Whittata, Andamooka Ranges, 154, 30; S.A.M. R.2598, Lyndhurst, 157, 31; S.A.M. R.2257, Aldgate (2 specimens), 159, 31; 161, 33; S.A.M. R.2373, Penong, 171, 34; S.A.M. R.3144, Caroona, *via* Port Augusta, 153, 31; S.A.M. R.3147, Leigh Creek (3 specimens), 167, 35; 164, 34; 166, 33. In all of these specimens the temporals are 2 + 2 and the nasal contacts the preocular. This data gives an overall variation of 153–176 ventrals and 30–35 subcaudals for South Australian specimens.

*DENISONIA BRUNNEA sp. nov. (Fig. 2, 2a and b).

Holotype. S.A.M. R.3151, taken at Mount Wedge, near Elliston on the West Coast of Eyre Peninsula, South Australia by J. L. Harwood, Esq., on 29th July, 1907.

Diagnosis. Midbody scales in 17 longitudinal rows; ventrals 194; subcaudals 56; the anal is divided. The nasal forms sutures with the 1st, 2nd and 3rd upper labials. Uniform light brown dorsally, the supra-ocular scales being slightly darker; ventral surfaces uniform cream.

Type description. General proportions short, stout; head wide, distinct from the neck; snout rounded. Scale pattern fine; the length of a midventral scale is less than one-fifth of its width. Nasal undivided, joining the preocular and the 1st, 2nd, and 3rd upper labials; 3rd and 4th of six upper labials subocular; two postoculars. Maximum length of the internasals only half that of the prefrontals; frontal 1½ times longer than wide, as long as, but slightly wider than the supraoculars. Temporals 2 + 2, the lower anterior wedged between the 5th and 6th upper labials. Vertical diameter of the eye greater than its distance from the mouth and approximately equal to half the snout length.

Body scale counts and colour as given in the diagnosis.

The fangs are followed after an interspace by three short, stout conical teeth, these teeth being directed slightly backward. The fangs of this species appear to be large for its size, measuring almost 3 mm., while the following maxillary teeth measure only approximately ½ mm.

Measurements. 284 (240 + 44) mm.

Affinities. The general form and high ventral scale counts do not suggest immediate relationship with any described species. The scale counts are most nearly approached by those of *D. signata* Jan. of Queensland and New South Wales, but a comparison with several specimens from Mount Tambourine, Queensland, indicates the present species to differ in possessing higher ventral and subcaudal counts, entirely different colouration, and several other scalation differences evident from fig. 2, 2a and b.

DENISONIA CURTA (Schlegel). (Fig. 2, 1a and b.)

Naja curta Schlegel, 1837, Phys. Serp. ii, p. 486.

Brachyaspis curta Boulenger, 1896, Brit. Mus. Cat. Snakes, III, p. 353.

Three South Australian specimens of this interesting species were examined, S.A.M. R.2371, from Tintinarra, S.A.M. R.3160, from Coombe, and S.A.M. R.2285, a specimen with no definite locality data, but found in association with other specimens taken near Salt Creek on the Coorong.

Because of the superficial similarity of these specimens to several members of the genus *Denisonia,* thought was given to the reasons for the separation of the species as genotype of *Brachyaspis.* This separation appears to have been based on three characters, the marked distinction of the head from the neck

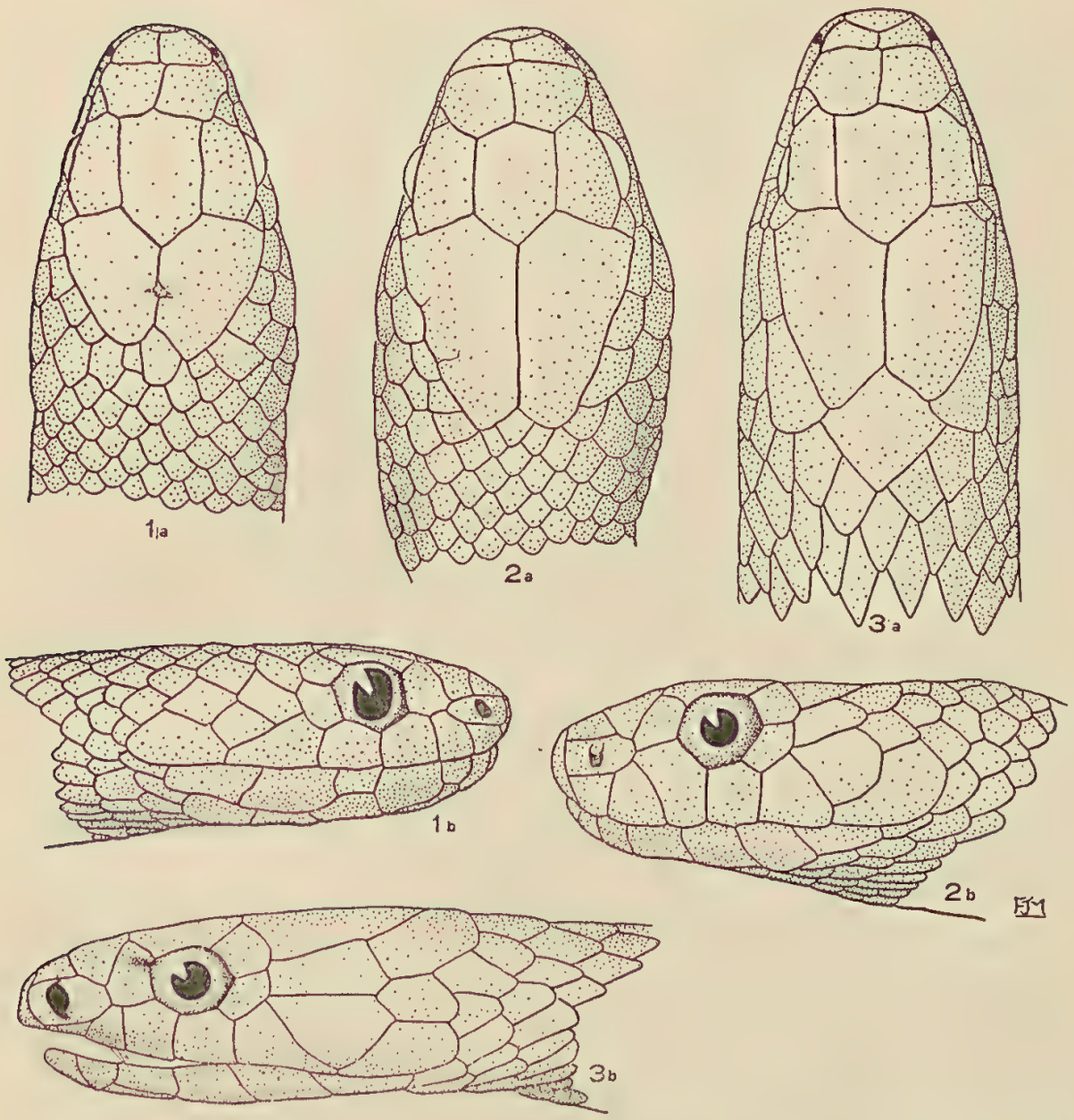

Fig. 2. 1a and 1b: *Denisonia curta* (Schlegel); dorsal and lateral views of the head (S.A.M. R2371). 2a and 2b: *Denisonia brunnea* Mitchell. Dorsal and lateral views of the holotype specimen (S.A.M. R3133). 3a and 3b: *Notechis scutatus* var. Dorsal and lateral views of the head (S.A.M. R3143).

and body, the dividing of the nasal and the strong enlargement of the anterior mandibular teeth. Assuming Gunther's figure (1862, pl. IX, fig. 11) to be of accurate proportion, the first of these characters must be very variable as none of the present specimens show the head to be more distinct than that of *D. suta* or *D. signata*. Kinghorn (1931, fig. 1) also seems to indicate a less marked distinction than that figured by Gunther. The dividing of the nasal is also inconstant, two of these specimens possessing undivided nasals, while in the

third it is partially divided by a shallow groove through the nostril. The anterior mandibular teeth are enlarged and recurved, but not sufficient to make this species unique in the genus *Denisonia*. On the above grounds *Brachyaspis* is referred to the synonomy of *Denisonia*. The fangs are followed after an interspace by four strongly recurved, solid teeth.

Noted variation of the material examined—midbody scales in 19 rows, 26–27 around the neck; ventrals 135–139; subcaudals 36–40, single; anal undivided. Temporals 3 + 3 except on the left side of R.2371, where it is 2 + 3; anterior temporals slightly larger than posterior. Kinghorn (1931, fig. 1) figures elongated anterior temporals. The shape and size of the frontal is variable.

ACANTHOPHIS ANTARCTICUS ANTARCTICUS (Shaw).

Boa antarctica Shaw, 1794, Nat. Miscell., pl. mxxxv.

ACANTHOPHIS PYRRHUS Boulenger.

Acanthophis pyrrhus Boulenger, 1898, Ann. and Mag. Nat. Hist., (7), 2, p. 75.

NOTECHIS SCUTATUS SCUTATUS (Peters).

Naja (*Hamadryas*) *scutata* Peters, 1861, Monatsb. Akad. Wiss. Berlin, p. 690.

In describing the supposed western subspecies *occidentalis*, Glauert (1948, p. 139–141) appears to have been convinced that the scale variation recorded by Kinghorn (1929a, p. 146) is typical. However, the type specimen according to Peters had body scale counts of 17, 173 and 45, so that the population from which Kinghorn took his data is not typical of the species, assuming the variation recorded in his handbook to be not distorted by typographical errors. A survey of the variation listed below indicates the body scale counts to be very unstable, and therefore of little diagnostic value. Further, the colour variation shown by specimens in the South Australian Museum collection completely envelops that recorded in earlier references to that species.

This casts doubt on the recognition of *occidentalis* as a western subspecies, the only evident differences being the predominance of one of the many colour patterns shown by South Australian specimens and the possession of 17 rather than 19 midbody scales.

As recorded for Western Australian specimens by Glauert (*op. cit.*), South Australian Tiger Snakes are restricted to swampy habitats.

The following body scale data has been considered. Midbody scales in 15 rows; Tasmania (5 specimens), possessing 172, 172, 168, 164, 172 ventrals and ?, 54, 50, 53 and 48 subcaudals.

Midbody scales in 17 rows: Warren River, Western Australia (2 specimens), 159, 159 ventrals and 44, 46 subcaudals; near Rendelsham, South Australia (2 specimens), 167, 161 ventrals and 49, 44 subcaudals; Yorke Peninsula, South Australia, 170 ventrals and 46 subcaudals; Mannum, South Australia, 168 ventrals and 47 subcaudals; Sleaford Mear, Eyre Peninsula, South Australia, 167 ventrals and 47 subcaudals; Flinders Island, Bass Strait, 177 ventrals and 53 subcaudals; Tasmania (7 specimens), 173, 173, 170, 173, 169, 166, 159 ventrals and 50, 52, 51, 56, 55, 54, 49 subcaudals; Hobart, Tasmania, 179 ventrals and 50 subcaudals; Kangaroo Island, South Australia, 154 ventrals and 51 subcaudals; Junction of Murray and Darling Rivers (3 specimens), 168, 168, 169 ventrals and 36, 46, 54 subcaudals.

Midbody scales in 19 rows: Milang, South Australia, 163 ventrals and 47 subcaudals; Mannum, South Australia (2 specimens), 165, 163 ventrals and 47, 47 subcaudals; Murray Bridge (2 specimens), 160, 163 ventrals and 48, 52 subcaudals; Crowes, Otway Ranges, Victoria, 164 ventrals and 50 subcaudals; Penneshaw, Kangaroo Island, South Australia, 169 ventrals and 45 subcaudals; Eleanor River, Kangaroo Island, South Australia, 175 ventrals, 48 subcaudals; Deep Creek, Kangaroo Island, South Australia, 184 ventrals and 45 subcaudals; Sydney, New South Wales (2 specimens), 175, 179 ventrals and 56, 54 subcaudals; New South Wales, 185 ventrals and 61 subcaudals; Kangaroo Island, South Australia (2 specimens), 178, 172 ventrals and 54, 51 subcaudals; Prahran, Victoria, ventrals not quoted, 49 subcaudals; Junction of Darling and Murray Rivers, 168 ventrals and 50 subcaudals.

Data taken from many specimens without accurate locality data was also considered. Glauert (1948) records variation of 17 (32 specimens) to 19 (8 specimens) midbody scales, 135 (1 specimen) and 146–162 (39 specimens) ventral scales and 30–52 subcaudals for the type series of *occidentalis*. Kinghorn (1929, p. 146) records a variation of 128–136 ventrals and 30–35 subcaudals. In addition to the South Australian Museum collection the following references were utilized in the compilation of the above list—Boulenger (1896, p. 352), Kinghorn (1921, p. 145), Loveridge (1934, p. 290), and McCoy (1878, pp. 11–12).

S.A.M. R.3143 from Tailem Bend, South Australia, is an interesting specimen. It possesses several aberrant characters which have been considered worth describing and figuring (see fig. 2, 3a and b). Midbody scales in 19 rows; ventrals 165; subcaudals 56, all single. The dorsal scales are very elongate, more elongate than those of an average specimen of the same total length. A large rhomboidal occipital is present. The colouring is also distinctive, the head being dark grey; body with a wide coppery brown middorsal stripe lightening

ventrolaterally to bright lemon yellow ventrally, all colours deepening posteriorly. Underside of the head white with a yellow tinge on the lower anterior temporal and 4th and 5th upper labials. Colours described from life. The specimen measures 388 (327 + 61) mm.

NOTECHIS SCUTATUS, var. NIGER Kinghorn.

Notechis scutatus var. *niger* Kinghorn, 1921, Rec. Aust. Mus., xiii, 4, p. 145.

This snake was originally described as a melanotic variety restricted to Kangaroo Island, South Australia. However, specimens identical with the Kangaroo Island examples have recently been taken at localities on the southern ends of Yorke and Eyre Peninsulas, South Australia.

The reoccurrence of this colour pattern in two areas totally independent of the type locality raises an interesting problem. Is this an example of impressed variation or has it a definite genetic basis? Specimens taken in the lower south-eastern districts of South Australia resemble Tasmanian specimens in showing a darkening of the dorsal colouring with consequent obliteration of the cross-bands, but none show the dark ventral colouring characteristic of *niger*. The body scale variation falls within that recorded for the type race and is included in the above list.

NOTECHIS ATER (Krefft).

Hoplocephalus ater Krefft, 1866, Proc. Zool. Soc. London, p. 370.

It is noted that Glauert (1948, p. 141) places *ater* as a subspecies of *scutatus*. As but a single example of this snake has been taken, the species being unrepresented in the South Australian Museum collection in spite of extensive collecting in the Flinders Ranges, our present knowledge gives no grounds for regarding it a subspecies of *scutatus*.

RHYNCHOELAPS BERTHOLDI (Jan.)

Elaps bertholdi Jan., 1859, Rev. et Mag. Zool., p. 123.

RHYNCHOELAPS FASCIOLATUS (Gunther).

Rhinelaps fasciolatus Gunther, 1872, Ann. and Mag. Nat. Hist., (4), ix, p. 34, pl. v, fig. 4.

*At least one additional species of *Rhynchoelaps* occurs in South Australia, and specimens have been identified tentatively as *R. semifasciata* Gunther or *R. australis* Krefft. However, the group is badly in need of revision, one object

of such work being to determine the stability of certain scale details used to characterize several of the recently described "shovel snouted" species. This is being undertaken by Mr. J. R. Kinghorn of the Australian Museum, Sydney, and a selection of South Australian Museum specimens has been sent for his examination. His identification of the South Australian species is awaited with interest.

*FURINA ANNULATA (Gray).

Calamaria annulata Gray, 1841, in Grey's Journ. Exped. West. Austral., 2, p. 443.

This species is quite common throughout the State.

*FURINA BIMACULATA Dumeril and Bibron.

Furina bimaculata Dumeril and Bibron, 1854, Erpet, Gen., 7, p. 1,240.

A single specimen, S.A.M. R.2302, was collected at Kingoonya, South Australia.

REFERENCES CITED.

Boulenger, G. A. (1896) : Cat. Snakes Brit. Mus., III, (London).
Glauert, L. (1948) : *Western Australian Naturalist,* 1, pp. 139–141.
Gunther, A. (1862) : *Ann. Mag. Nat. Hist.,* (3), IX, p. 130, pl. ix, fig. 11.
Kershaw, J. A. (1918) : *Victorian Naturalist,* p. 31.
Kinghorn, J. R. (1920) : *Rec. Aust. Mus.,* XIII, pp. 110–117.
Kinghorn, J. R. (1921) : *Rec. Aust. Mus.,* xiii, p. 145.
Kinghorn, J. R. (1929) : *Rec. Aust. Mus.,* XVII, pp. 76–84.
Kinghorn, J. R. (1929a) : Snakes of Australia, (Sydney).
Kinghorn, J. R. (1931) : *Rec. Aust. Mus.,* XVIII, p. 85.
Loveridge, A. (1934) : *Bull. Mus. Comp. Zool. Harv.,* LXXVII, 6, pp. 243–383.
McCoy, F. (1878) : *Prod. Zool. Vict.,* dec. 1, pp. 11–12.
Waite, E. R. (1929) : Reptiles and Amphibians of South Australia (Adelaide).

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